POWER

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The Eternal Disagreement

DR. M. W. ALEXANDER, of the National Industrial Conference Board, brought out again in his talk at the Shawnee meeting of the American Boiler Manufacturers' Association, the fact that it is not money that the wage earner is interested in, but the purchasing power of his day's work.

I say "again," for it has been insisted upon several times upon this page and in other places—but simple as it is, it does not seem to "get over."

To take an example used by Dr. Alexander, if I get five dollars a day and shoes are five dollars a pair, I can put my day's work against that of all the people who contributed to the making and transportation and sale of that pair of shoes, and get it for a day's labor. If I get ten dollars a day and shoes cost twelve, and everything else in proportion, I would be worse off than when I had the lower wage but greater purchasing power.

What the wage earner ought to strive for and to strike for, if he has to strike at all, is not more dollars or less hours per day, but a reasonable share in the products of his labor.

There are four items that enter into the selling price of a service or a commodity, overhead, material, labor and profit. Suppose them divided as in the first column.

Overhead	30	60
Material	30	60
Labor	40	80
Cost	100	200
Profit	20	40
Selling Price	120	240

of which labor gets one-third.

Suppose that labor strikes and gets its wages doubled. Material is simply labor and would double also. Overhead is mostly directly referable to labor and would double too and you would get the second column, in which labor gets the same proportion of its product that it did before.

The purchasing power of the day's work has not been increased. The probability is that it will be less, for the "high price of labor" will be used as an excuse for "unconscionable profits."

The way to improve conditions generally, for the laboring man and for everybody else, is to keep down the cost of the things. Not by cutting the share of labor below its reasonable amount, but by increased efficiency and the avoidance of waste and cost-producing practices. If a workman does only one-half as much in a day as he can reasonably do, he doubles the labor cost, and the overhead cost per unit, and the material cost too, if the laborers producing and distributing the material do the same. Allowing the same percentage of profit then, he has voluntarily cut the purchasing power of his day's work in two.

Weal comes only with work. The system that limits the amount or kind of work that a man shall do, or insists upon more men for a given job than it requires, is economically unsound and reacts not only upon those who practice it, but upon all who earn their living by the sweat of their brows.

F. R. Low

The Unaflow Steam Engine Industry

In spite of a prevalent opinion to the contrary the manufacture of reciprocating steam engines is showing a healthy increase. This condition has been brought about by the introduction of the high-efficiency unaflow engine.

FROM 1910 to 1914 those firms in the United States whose activities were centered chiefly in the building of reciprocating steam engines faced a most disturbing condition. The development of the steam turbine from its introduction in 1905 had been rapid both by reason of its lower manufacturing costs and its superior steam economy compared to many prevailing types of reciprocating steam engines.

The turbine's superior steam economy became an actuality only when condensing operation was possible. Even here its thermal superiority lay almost entirely in the fact that the reciprocating steam engine had large heat losses due to condensation and re-evaporation of

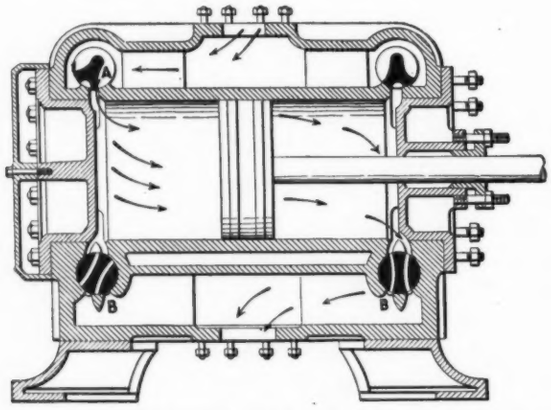


FIG. 1. ENGINE SHOWING LOSS BY HEAT TRANSFER

part of the steam supply. This required more steam to be fed to the cylinder to deliver a horsepower than was needed in the case of the turbine.

It was apparent to all that if the reciprocating steam engine was to hold its own, these losses must be eliminated. This had been attempted by four-valve construction, live-steam jacketing, compound and triple expansion, and by the use of superheat. Each had an influence upon the economy, but the major part of the cylinder losses still remained. At this point, when engine building was at low ebb, the unaflow steam engine was introduced into the United States with a consequent though gradual revival of the industry to its

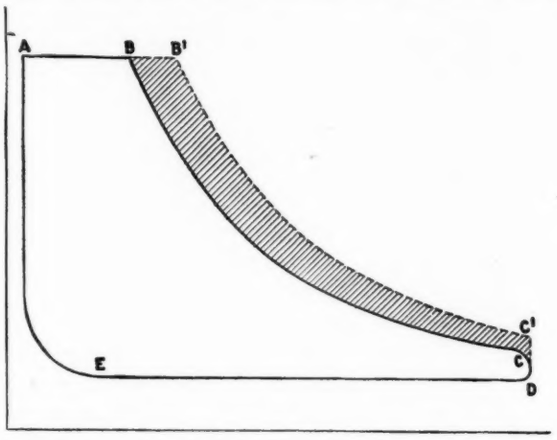


FIG. 2. INDICATOR DIAGRAM OF CORLISS ENGINE

present state of activity, in which more than a dozen firms are engaged in its manufacture.

A brief outline of the reasons why the unaflow engine was able to eliminate the losses present in other engines is offered. In the usual four-valve engine, for example the Corliss shown in Fig. 1, the live or boiler steam enters through the steam valve and exerts a pressure against the piston, causing the latter to do work on the crank. At some point the steam valve *A* closes and the expansive power of the steam comes into play, forcing the piston to the end of its stroke. As the volume increases the pressure decreases, and since the temperature of the steam depends on its pressure, the former falls rapidly. When the exhaust valve *B* opens, the new cool steam sweeps back through the cylinder, across the cylinder head and out through the exhaust. The cylinder walls are above the exhaust temperature, and the cylinder condensate re-evaporates and carries out a lot of heat. When the piston again reaches the left end of the cylinder, the steam valve opens, boiler steam enters and the cycle is repeated. The cylinder walls are at a low temperature, and much of the live steam immediately condenses. The effect is

such that often 50 per cent of the steam entering is condensed and does little work.

An indicator diagram *ABCDE* from a Corliss engine is shown in Fig. 2. The area of this diagram is proportional to the work done by the steam in the cylinder. Condensation of part of the steam causes a loss

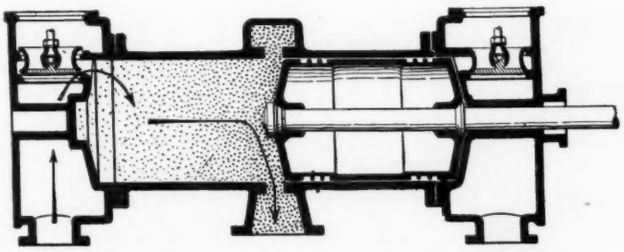


FIG. 3. FLOW OF STEAM IN UNAFLOW ENGINE

represented by the cross-hatched area of the diagram. It is obvious that this loss in the steam engine, not being present in the turbine, where the flow of steam is in one direction from the inlet to the outlet, put the former in a decidedly bad position.

Although others had already patented an engine having the same general feature of a central exhaust which has given the engine its name, to Dr. J. Stumpf must be awarded the chief credit for the commercial development of the unaflow engine.

The unaflow differs from other steam engines in the cylinder construction. In the Stumpf engine steam enters at the cylinder head and after doing work passes out through a row of exhaust ports uncovered by the piston at the end of its stroke. If the engine is double-acting, as is usual, the cylinder must be approximately twice as long as the piston stroke and the piston must

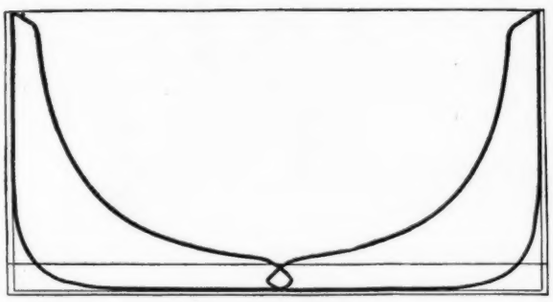


FIG. 4. UNAFLOW INDICATOR DIAGRAM

be as long as its stroke less the exhaust-port width. The row of exhaust ports is then in the middle of the cylinder, as in Fig. 3.

The direction of the steam flow is always from the head toward the center. No heat is picked up from the hot cylinder head and lost through the exhaust. The piston covers the ports when it has moved some 10 per cent of its return stroke and traps a cylinderful of the steam at the exhaust pressure. This steam is compressed to practically boiler pressure by the action of the piston on the compression stroke and its temperature is raised by the work of compression until at the end of this stroke it is equal to that of the incoming live steam. The head is kept hot by the live-steam jacket, and little heat is either lost or absorbed from the cylinder walls by the steam. The loss due to cylinder condensation is then almost entirely eliminated. The only loss of any consequence that remains is due to the expansion being incomplete; that is, the steam does not drop during expansion to the pressure of the exhaust line. The indicator diagram of the unaflow engine appears in Fig. 4. The expansion and compression lines are almost true adiabatic, showing that there is still little heat lost to the cylinder walls. By the elimination of the cylinder condensation losses the unaflow is able to deliver the same amount of work with

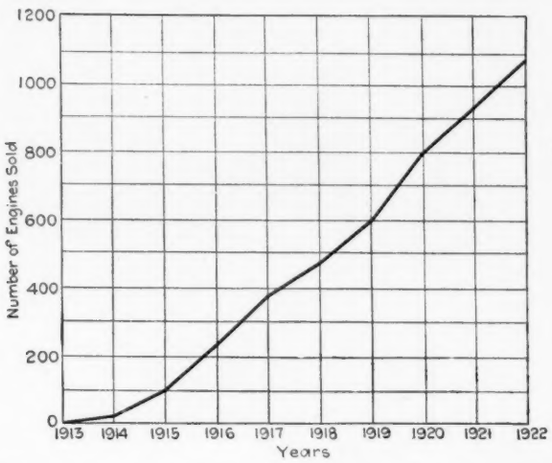


FIG. 5. NUMBER OF UNAFLOW ENGINES IN SERVICE

a large saving in steam over that required by other steam engines.

The adoption of the unaflow engine was by no means immediate upon its introduction into the United States. In 1913 one builder engaged in its manufacture, being followed from year to year by others, until at the present time thirteen companies manufacture this engine, many with considerable modification of the original valve-gear designs, while a number of refrigerating-machine companies purchase unaflow cylinders to mount on the compressor frame. Fig. 5 shows the number of engines placed in service from 1913 to

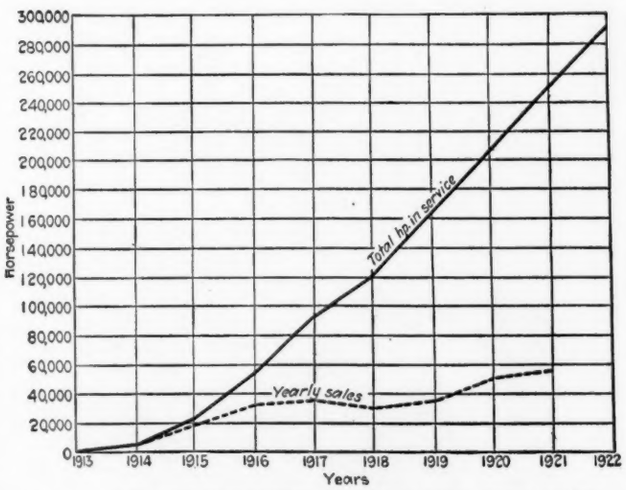
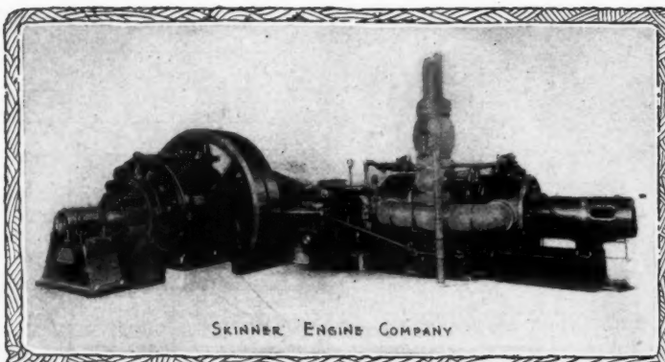


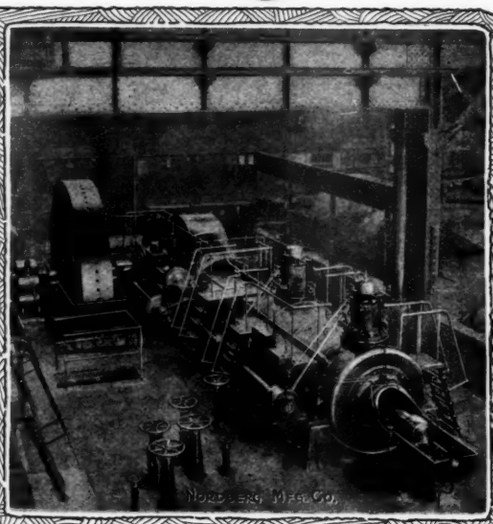
FIG. 6. UNAFLOW ENGINE HORSEPOWER INSTALLED

Jan. 1, 1922, while Fig. 6 gives the growth in total horsepower. The curves indicate that the average horsepower per engine sold has remained around 250. From this may be drawn the conclusion that the unaflow is especially suitable for plants having units of from 100 to 500 hp. This is by no means the whole story, for while the unaflow cannot be expected to be

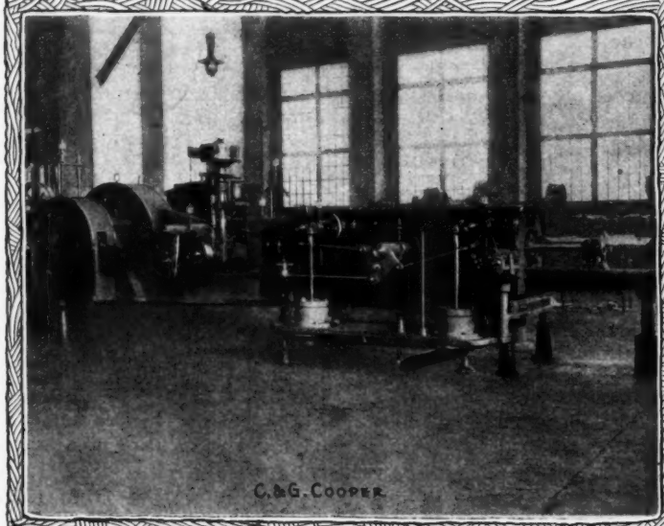
Unaflow Steam Engines



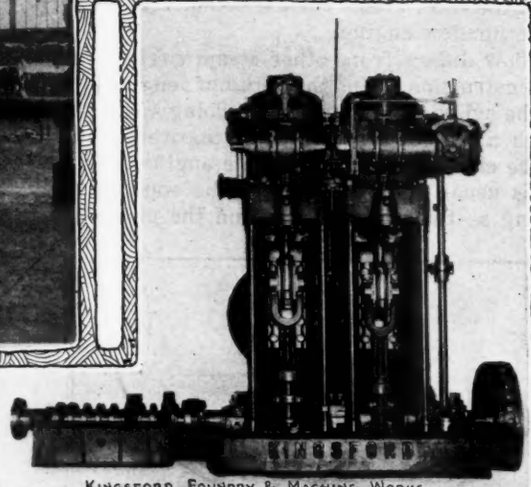
SKINNER ENGINE COMPANY



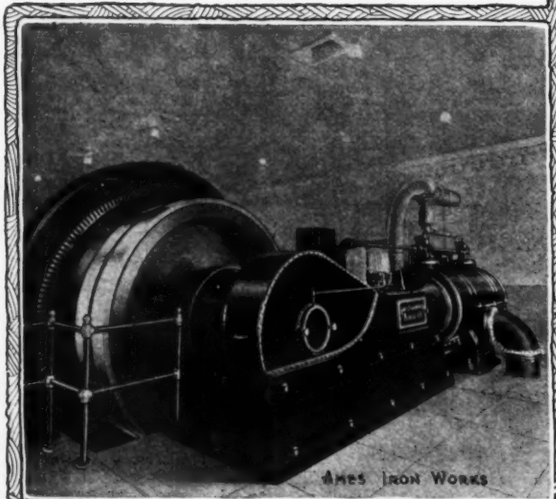
NORBERG MFG. CO.



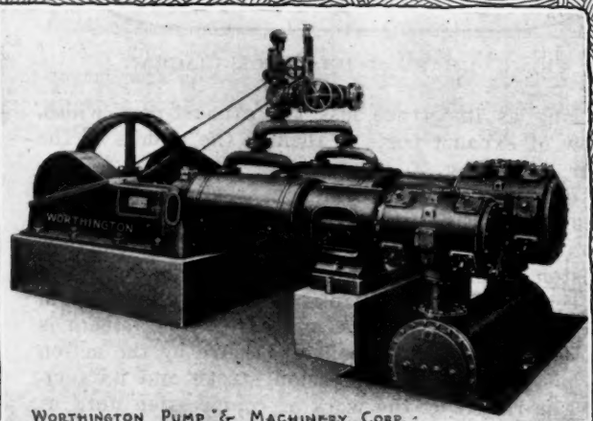
C. & G. COOPER



KINGSFORD FOUNDRY & MACHINE WORKS

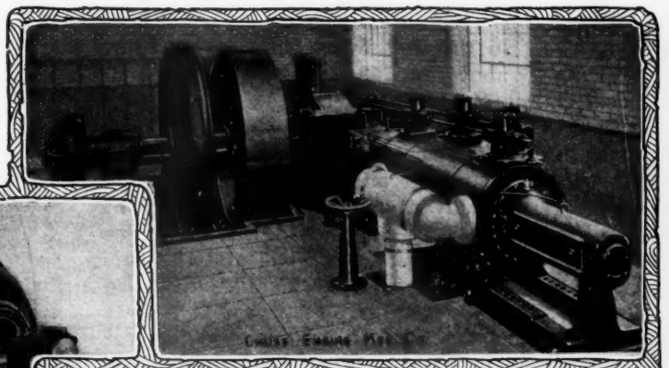


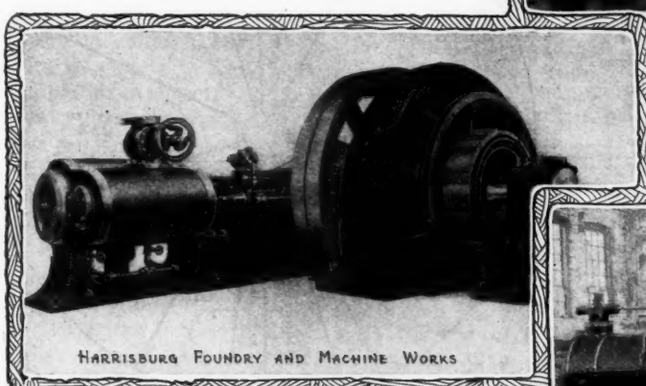
AMES IRON WORKS



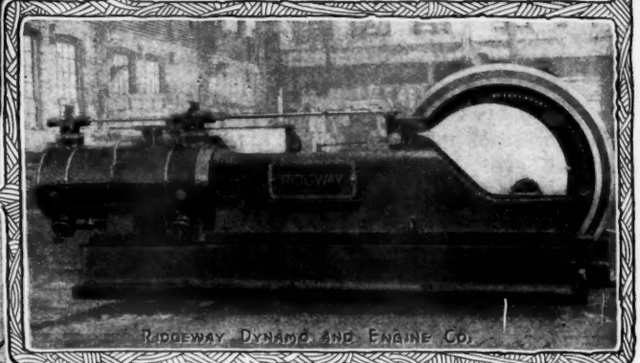
WORTHINGTON PUMP & MACHINERY CORP.

# of American Manufacture

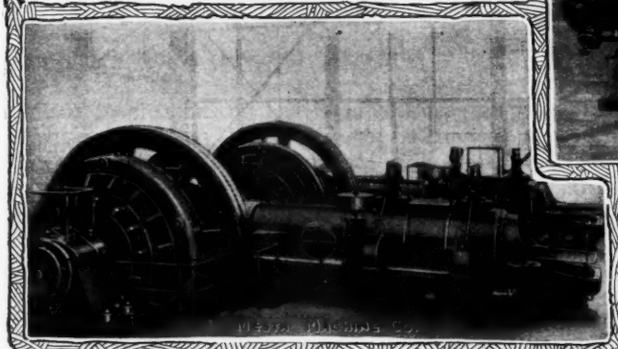


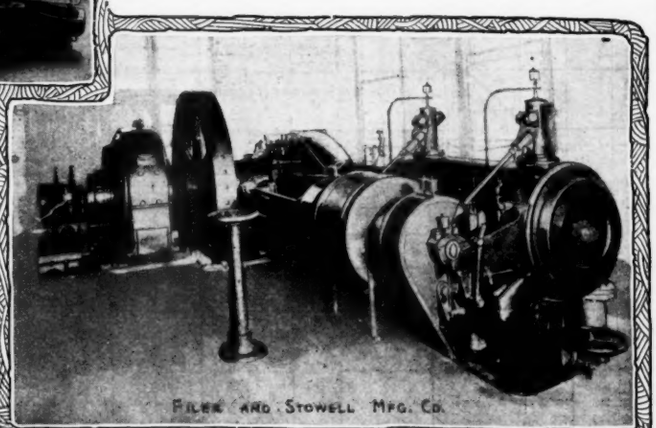


HARRISBURG FOUNDRY AND MACHINE WORKS

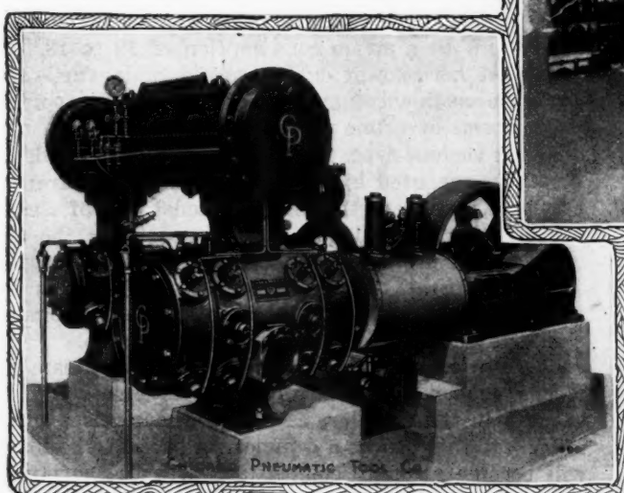


RIDGEWAY DYNAMO AND ENGINE CO.

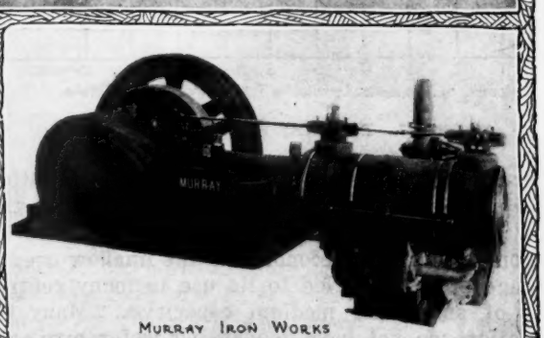




FILER AND STOWELL MFG. CO.



PNEUMATIC TOOL CO.



MURRAY IRON WORKS

built in units of a size to compete actively with the large turbines, still in certain industries units of 5,000 to 20,000 hp. will be used in preference to other forms of power.

Notwithstanding last year was one of depression in all manufacture, Fig. 7, which gives the monthly shipments of unaflow engines both by number of cylinders and by horsepower, shows that the demand has been fairly sustained. In the first five months of 1922 the sales were slightly above the 1921 rate.

An investigation of the unaflow engine situation indicates that the major part of these engines have replaced old inefficient steam engines, or have gone into industries such as the steel mills where reciprocating engines have certain advantages over other forms of power. In Fig. 8 is shown a chart giving the industries into which the unaflow engine has gone and the percentage of the total unaflow output installed in these industries.

The steel-mill industry has shown a marked interest in the unaflow, for the engine is especially suited for rolling-mill service, being more flexible than the electric drive. At the present time one builder has two engines driving merchant rolls, each engine being guaranteed to develop 5,000 hp. continuously, and a 20,000-hp. unit is now in process of manufacture. This is the largest steam engine ever built in this country and will be fully described in *Power* at a later date. Unaflow engines are ideal for rolling-mill work since a variation from 50 per cent to 200 per cent of normal alters the economy less than 10 per cent.

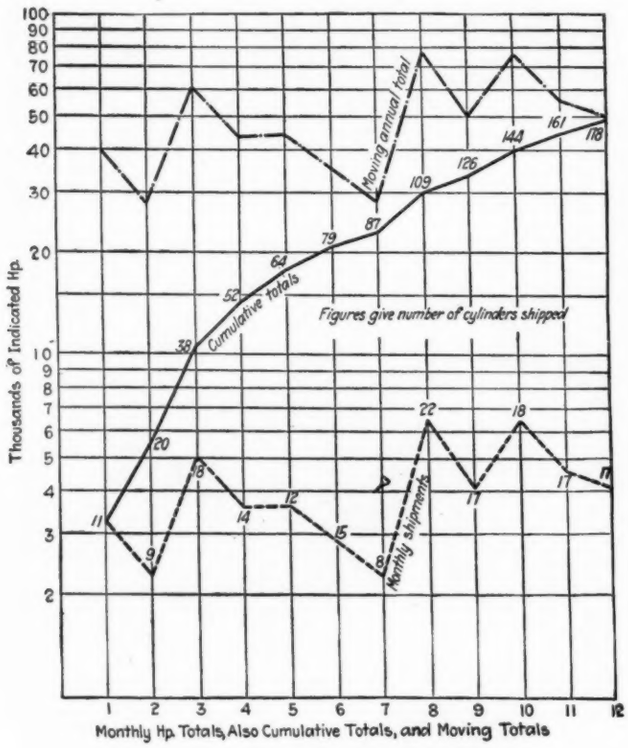

Thousands of Indicated Hp.
Moving annual total
Cumulative totals
Figures give number of cylinders shipped
Monthly shipments
Monthly Hp. Totals, Also Cumulative Totals, and Moving Totals

FIG. 7. ENGINES SOLD IN 1921

The consistently high economy of the unaflow over a wide range of load has led to its use in many central stations of small and medium capacities. Many of these stations do not have condensing water available and so operate non-condensing. Neither the steam turbine nor the usual reciprocating engine is economical under non-condensing conditions. On the other hand although condensing operation is the more economical the unaflow does show a high economy even where operating non-condensing.

In the days of distilled-water ice making there was a demand for steam for distilled water which was almost equal to the steam consumption of the engine driving the compressor. There was no inducement to install a more economical engine which would necessitate the use of some live steam to the distilling apparatus to make up the deficiency in the supply of exhaust steam. The development of the raw-water ice system removed the difficulty, and the demand was then for an economical prime mover. More and more attention is being directed toward the unaflow engine, with which it is possible to obtain 18 tons of ice per ton of coal. In the chart the ice plants having unaflow engines have been classified with food products, the engines in this class being 13.5 per cent of the total.

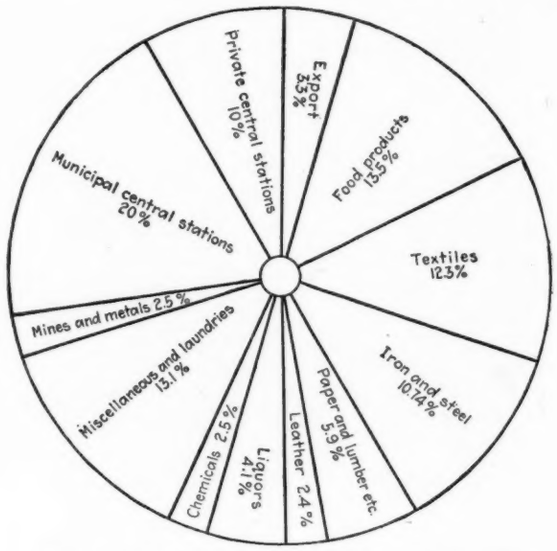


FIG. 8. UNAFLOW ENGINES BY INDUSTRIES

In the textile industries there is a drift back to the individual plant, and up to the present 12.3 per cent of the unaflow horsepower has been installed in such plants. With a steam consumption of 12 to 13 lb. per indicated horsepower under considerable variation in load, the unaflow can and has been able to compete with other forms of prime movers.

While various types of valve gearing and cylinder construction are used by the different manufacturers, the essential feature of the uni-directional flow of steam in the cylinder is retained. As a consequence the steam consumption of the many different makes of engine is almost identical, the choice between the engines being in the main dependent upon a preference for some constructive detail found in a particular design.

The use of the energy remaining in the steam after it has done work in the cylinder, to create a partial vacuum in the cylinder, has become more than a possibility. If this proves a commercial success, the unaflow will become strongly competitive with the turbine for condensing work.

Recently, there has been a marked interest in small engines for tractor or truck drive. It would seem that the bus transportation field would offer especial inducements to the unaflow engine designer.

Textile Plant Superheats Exhaust Steam for Process Work*

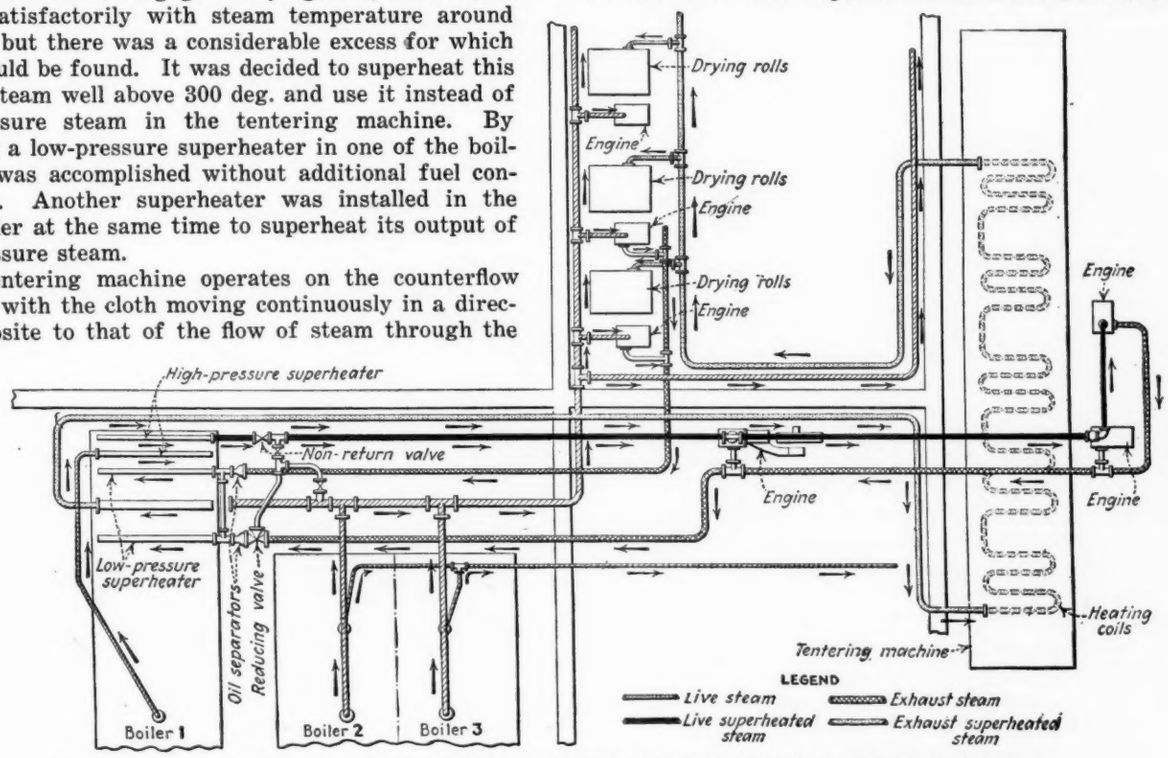
IN addition to supplying both superheated and saturated high-pressure steam to operate engines, the Easton Finishing Company, Easton, Pa., superheats the steam exhausted from the engines and uses it to dry cloth in a tentering machine. From this the steam goes to drying rolls, where it gives up the rest of its heat. Since the tentering machine was previously supplied with high-pressure steam or exhaust steam at high back pressure, the change has resulted in a substantial reduction in the coal bill.

THERE are certain conditions under which serious consideration may be given to the use of superheated steam in process work. An editorial discussing some features of the general problem may be found in this issue. As an example of a specific application this article describes an unusual installation in the plant of the Easton Finishing Co., Easton, Pa. This plant contains a large "tentering" machine which dries and stretches cloth by passing it, while under tension, over steam-heated coils. For this work a steam temperature around 300 deg. F. is required. This was formerly obtained by the use of saturated high-pressure steam. Several engines furnished exhaust steam at 15 lb. gage to drying rolls, which could operate satisfactorily with steam temperature around 250 deg., but there was a considerable excess for which no use could be found. It was decided to superheat this exhaust steam well above 300 deg. and use it instead of high-pressure steam in the tentering machine. By installing a low-pressure superheater in one of the boilers this was accomplished without additional fuel consumption. Another superheater was installed in the same boiler at the same time to superheat its output of high-pressure steam.

The tentering machine operates on the counterflow principle with the cloth moving continuously in a direction opposite to that of the flow of steam through the coils. For this reason it is not necessary to have a constant temperature for the whole length of the heating coil. Moreover, the actual amount of heat required for the process is only a small fraction of that contained in the available exhaust steam. This, together with the fact that a fairly high temperature is necessary, particularly at the point where the cloth leaves the machine, favored the use of superheated exhaust steam with provision for passing it afterward to the drying rolls, where its whole latent heat would be available. Fig. 1 shows the general layout. At the left may be seen the three horizontal-return-tubular boilers which generate all the steam used in the plant. Boilers 2 and 3 have no superheaters. They are used to produce saturated steam at 100 lb. pressure for use in the drying-roll engines shown in the upper center of the drawing. Boiler 1 contains two superheaters—one for the high-pressure steam generated by this boiler and the other for exhaust steam.

The location of these superheaters in boiler 1 is more clearly shown in Fig. 2. Steam at 100 lb. gage pressure enters the high-pressure superheater at *E* and leaves at *D*, with a superheat of about 150 deg. The exhaust superheater has three headers, *A*, *B* and *C*. Saturated exhaust steam at about 15 lb. gage enters through *A* and *C* and leaves through *B* with about 150 deg. superheat (total temperature about 400 deg.).

Turning again to Fig. 1, the high-pressure super-



FIGS. 6 TO 15. DIAGRAMS OF MECHANICALLY OPERATED TYPES OF REVERSING SWITCHES THE EASTON FINISHING COMPANY

*Information supplied by the Superheater Company.

heated steam leaving boiler 1 passes out to three engines, whose exhaust is returned to the two inlet headers of the exhaust superheater. The saturated high-pressure steam from boilers 2 and 3 goes to the drying-roll engines. Their exhaust is brought back to the inlet headers of the low-pressure superheater, where it mingles with the exhaust of the three engines using high-pressure superheated steam. A cross connection is used to equalize the steam entering the two inlet headers of the low-pressure superheater.

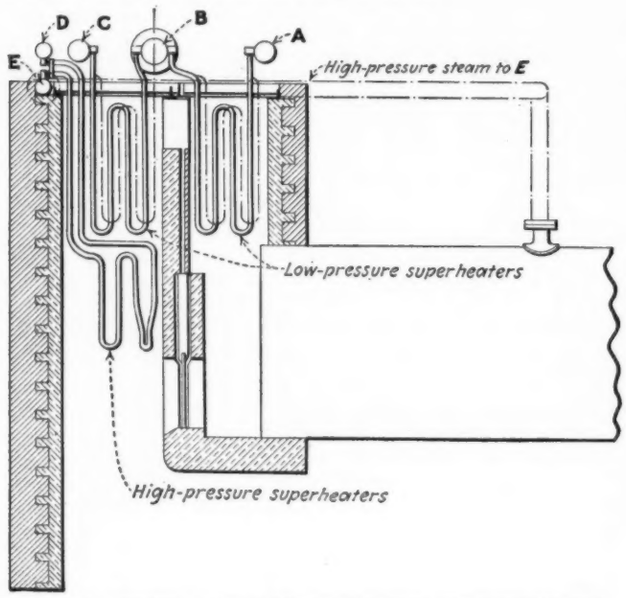


FIG. 2. HIGH- AND LOW-PRESSURE SUPERHEATERS IN SETTING OF BOILER 1

The high-pressure steam generated by boiler 1 enters the high-pressure superheater through the header *E* and leaves through *D*. Exhaust steam from the various engines is brought into the low-pressure superheater through two inlet headers, *A* and *C* and leaves through the header *B*.

In order to insure a constant flow of steam through the exhaust superheater whenever boiler 1 is in operation, a reducing valve is provided which automatically admits steam to the low-pressure superheater whenever the pressure of the exhaust steam falls below 15 lb. gage. This supply may come from either the high-pressure superheated steam or the high-pressure saturated steam, according to the setting of gate valves located in the corresponding connections to the reducing valve. The two gate valves and the reducing valve are shown in Fig. 1 at the right of boiler 1. The superheated exhaust steam is carried through the coils of the tentering machine (shown at the right) and then passes in a saturated or slightly superheated condition to the drying rolls (shown in the upper center).

In drying and straightening goods in the tentering machine, the heated air is not allowed to escape after it has passed up through the cloth, but is sent back over the pipe coils and heated to 220 deg. or more. Since this temperature is above the boiling point, the high moisture content of the air does not prevent rapid drying. Leakage in the ducts and drying room continually brings in fresh air and forces out some of that which is laden with moisture.

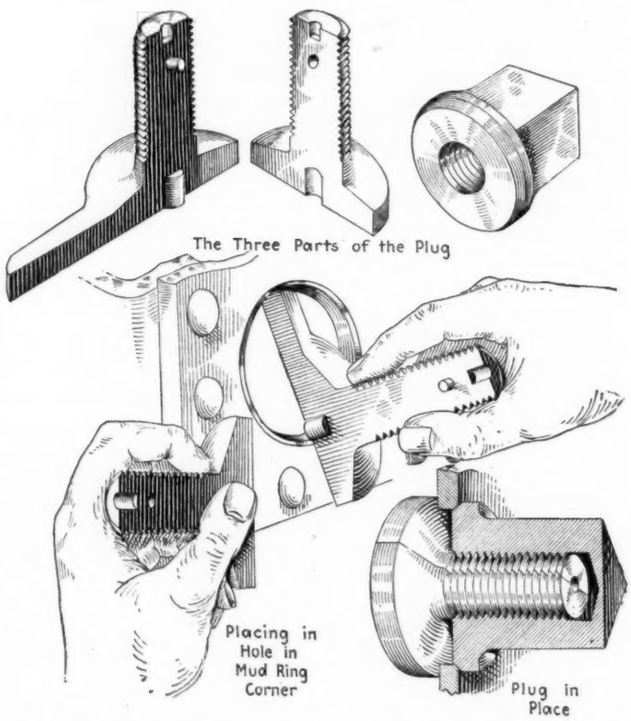
Before the superheaters were installed, it was necessary to use live steam, or exhaust steam with high back pressure, in the tentering machine. Under such conditions three boilers could hardly supply enough steam for all the engines and drying apparatus. Since the installation of the superheaters, considerable drying equipment has been added, but the three boilers handle the entire load without difficulty. It is planned to install superheaters in the other boilers. This it is believed, will still further reduce the coal bill.

Crist Washout Plug Prevents Thread Troubles

The washout plug shown in the accompanying illustration was designed in the first place for use in locomotives, but should apparently be just as useful in any stationary boilers of the locomotive type or, in fact, in any boiler having a water leg. In such boilers it has been customary to use a screw plug, which often causes trouble on account of rusting and banging up of the threads.

With this plug the hole in the boiler has no threads in it to wear out and may be of fairly large size. The job of washing out is therefore made easier, and tinkering and patching the mud ring corner is practically eliminated.

The plug is made in three parts, as shown at the top of the illustration. The extension on one of the halves is to keep the plug from turning around when it is in place and the nut is being screwed on. As shown in the drawing, the half with the extension is put into the hole first and is then drawn over to one side so that the other half can be inserted. The two halves are then drawn together and the nut screwed on, a bit of graphite



THREE-PIECE WASHOUT PLUG FOR LOCOMOTIVE TYPE AND SIMILAR BOILERS

being applied to the bevelled face of the nut and its seat so as to give a tight joint. It may be seen that no tools but a wrench are necessary to apply this plug. It is made for holes of 2½-in. diameter and up.

A patent has been obtained for the device, and it is being made and sold by Frank Crist and Co., Lima, Ohio.

Reversing Switches as Used in Electric-Motor Controllers

HOW to reverse the direction of direct-current motors is explained, and then a number of different types of reversing switches as used on motor controllers are discussed.

By B. A. BRIGGS

MOTOR applications may be divided into two general classes, non-reversing and reversing. In the non-reversing service the motor when in operation runs continuously in one direction; in the reversing service the motor runs for a period in one direction, after which its connections are changed and the machine is caused to run in the opposite direction for a given period. Any direct-current motor can be reversed by changing the direction of the current through the armature or through the field windings, but not in both at the same time. When a motor in non-reversing service is first connected up, it may run in the wrong direction. After testing, if this is found to be the case, then all that need be done is to interchange the armature or the field connections. This applies to all types of direct-current motors, whether series, shunt or compound wound. In this article the compound type will be referred to specifically, but what is said regarding this type can be easily applied to the other classes.

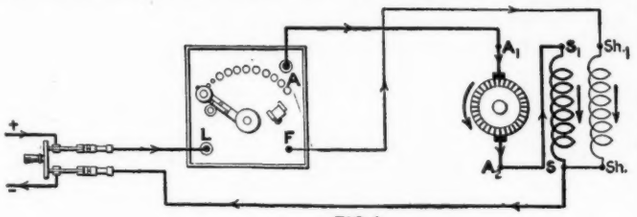


FIG. 1

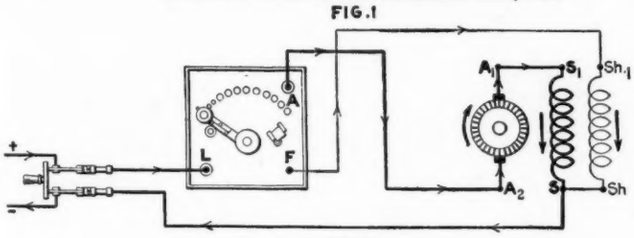


FIG. 2

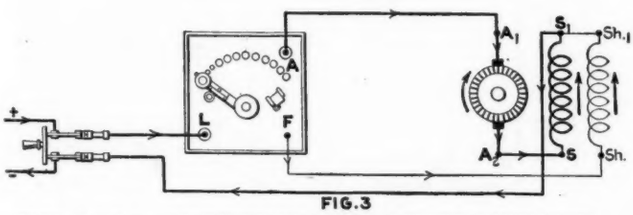


FIG. 3

FIGS. 1 TO 3. CONNECTION DIAGRAMS OF COMPOUND MOTORS, SHOWING HOW THE MOTOR MAY BE REVERSED

In Fig. 1 is shown a simple compound motor connected to a manual-type starting box. The direction of current through the windings is indicated by the arrowheads. It will be noted that the direction of current is the same in both the shunt and the series windings. By interchanging the armature connections as in Fig. 2, the direction of current is reversed through the armature, from that in Fig. 1, and this produces a reversal of rotation, as indicated by the curved arrows in the two figures. The direction of rotation can be changed by interchanging the field connections as in Fig. 3. This change of connections must be made so that the current is reversed in both field windings as done in the figure, or the field coils on the same polepiece will have opposite polarity and in most cases will cause the motor to operate unsatisfactorily. Unless there is some other good reason, such as obtaining a better arrangement of the connections, it is best to reverse a compound motor by crossing the armature connections, as this eliminates any chance of mixing up the field connections.

Where motors are frequently reversed—for example, in elevator service and many others—some type of switch is provided as a part of the motor controller to reverse the current through the armature. One of the simplest is an ordinary two-pole double-throw knife switch, as indicated at *S* in Figs. 4 and 5. With the switch thrown to the left, as in Fig. 4, the direction of the current is up through the armature, and if the direction of rotation is as indicated by the curved arrow, then, if the switch *S* is closed to the right as in Fig. 5, the direction of the current will be down through the armature and the direction of rotation will be as shown by the curved arrow, which is the opposite to that in Fig. 4. The arrangement shown in Figs. 4 and 5 is one that has been widely used in industrial applications for reversing motors started with a manual-type starting box. It has also been used, in a modified form, to a considerable extent in certain types of elevator controllers operated with a hand rope, and will be given further consideration in a future article on elevator controllers.

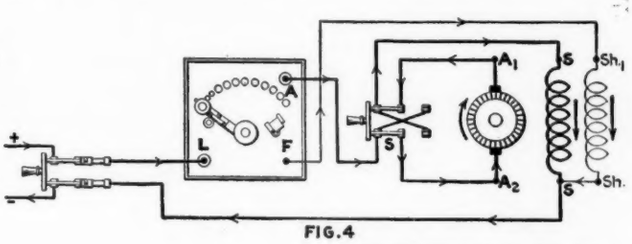


FIG. 4

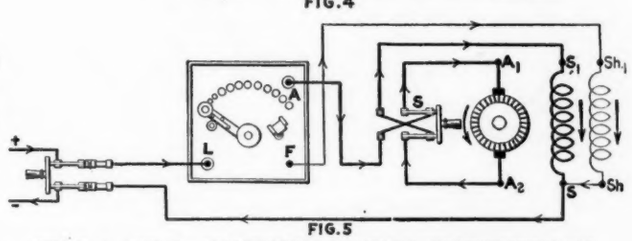


FIG. 5

FIGS. 4 AND 5. COMPOUND MOTORS CONNECTED TO DOUBLE-THROW, DOUBLE-POLE SWITCH, FOR REVERSING

In Figs. 6 to 15 are shown some types of reversing

switches that have been in use to some extent in mechanically operated electric elevator controllers. Just the armature and switch circuit are shown so as to make the diagrams simple. In each case it will be seen that a reversal of current through the armature is produced by throwing the switch from one position to the other. In a controller the switch is connected to the operating mechanism by some form of gearing, so that it operates in sequence with the rest of the control equipment.

The switch Figs. 6 and 7 is known as the 5-point type. It does not throw over, as does the two-pole double-throw type, but moves in a plane parallel to the surface of the control panel. The blades are hinged at *A* and *B* and held together by an insulated bar *C*. Following the circuits in the two figures shows how the current is

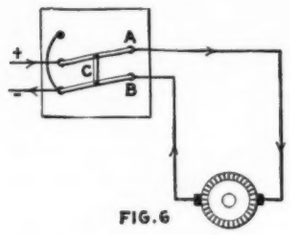


FIG.6

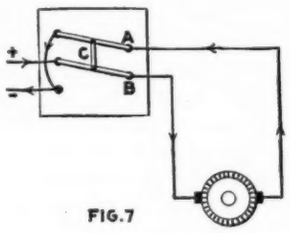


FIG.7

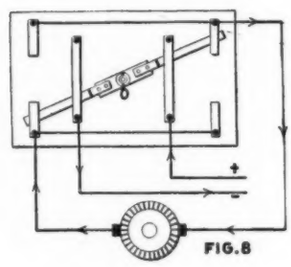


FIG.8

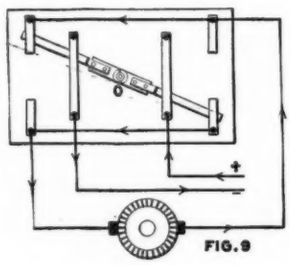


FIG.9

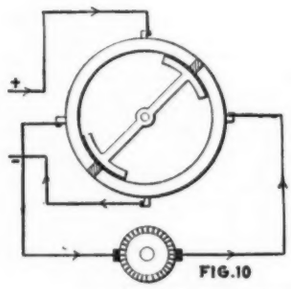


FIG.10

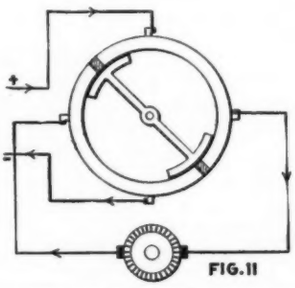


FIG.11

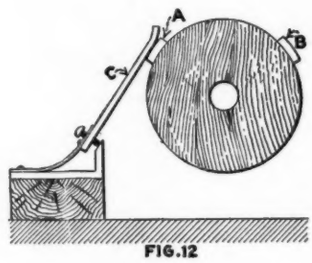


FIG.12

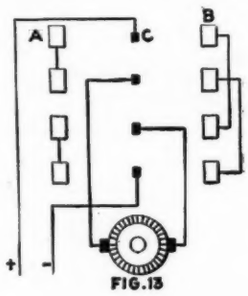


FIG.13

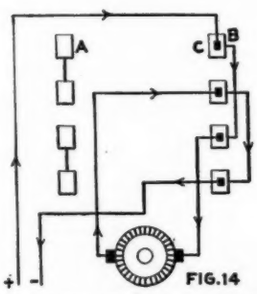


FIG.14

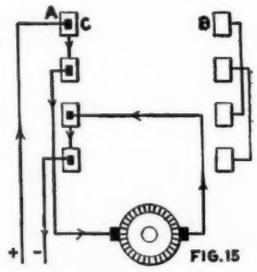


FIG.15

FIGS. 6 TO 15. DIAGRAMS OF MECHANICALLY OPERATED TYPES OF REVERSING SWITCHES

although in practice the movement is only about 60 deg. This switch is shown in two positions in the figures. Fig. 10 completes the circuit through the armature in one direction and Fig. 11 in the other direction, consequently, the armature's direction of rotation in one case will be the reverse of what it is in the other.

A reversing switch that has found wide application is the cylindrical type, shown in Figs. 12 to 15. In some forms the two rows of movable contacts, *A* and *B*, are mounted on a wooden cylinder, Fig. 12, so that they can be moved to two positions and complete the circuit through a row of stationary contacts *C*. The switch is shown diagrammatically in the open position, Fig. 13. If the switch is revolved to the left, the movable contacts *B* will rest on the stationary contacts *C* as in Fig. 14, thus completing the circuit through the armature as indicated by the arrowheads. By turning the cylinder to the right, the movable contacts *A* can be made to rest on the stationary contacts *C* as in Fig. 15, and this gives a reversal of the current in the armature, from that in Fig. 14.

Where reversing switches are operated by electromagnets, as on electrically controlled elevator machines, two switches are generally used—one for direction of the motor and another for the reverse direction. Figs.

reversed in the armature by throwing the switch from one position to the other.

In Figs. 8 and 9 is a modification of the reversing switch shown in Figs. 6 and 7, but, instead of the switch blades being mounted parallel to each other as in the former case, they are mounted one on each end of a crosshead, from which they are insulated. This switch moves a limited distance about the center *O* so as to take the two positions indicated. The arrowheads indicate the circuits and show that the current is in opposite directions through the armature for the two positions of the switch.

A form of reversing switch that was used to a large extent in an early type of elevator controller, many of which are in use today, is shown in Figs. 10 and 11. This switch consists of two metal semicircles insulated from each other and mounted so they can be revolved,

16 and 17 show diagrammatically two such switches. Normally, both contactors are open, but with the control switch *S* closed as in Fig. 16 coil *A* is energized and closes contacts *C* and *D* as shown. This completes the motor circuit as indicated by the arrowheads on the heavy lines. If the control switch *S* is closed, as in Fig. 17, then coil *B* will be energized and close contacts *E* and *F*. This completes the circuit through the motor in a reverse direction, as indicated by the arrowhead. These contactors move vertically up and down the face of the control panel; however, many of the modern contactors move at right angles to the surface of the panel. One of this type is shown in Fig. 18. Two of the contactors connected to reverse the current through the armature of a motor are shown diagrammatically in Figs. 19 and 20. With the control switch *S* closed to the left, as in Fig. 19, coil *C* on contactor *A* will be

energized, causing this contactor to close and completing the circuit through the motor, as indicated by the arrowheads on the heavy lines. With switch *S* closed to the right as in Fig. 20, coil *D* is energized and closes contacts *B* which completes the circuit through the motor's armature in a reverse direction from that in Fig. 20, thus producing a reverse direction of the motor's rotation. The reversing switches described in the foregoing give a general idea of the principles involved. With these as a background the reader should have no difficulty in understanding the operation of any type that may be found on a controller.

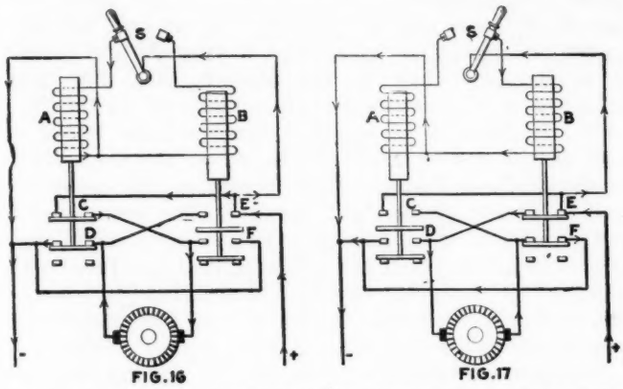


FIG. 16 FIG. 17

FIGS. 16 AND 17. MAGNET-TYPE REVERSING SWITCHES THAT OPERATE VERTICALLY

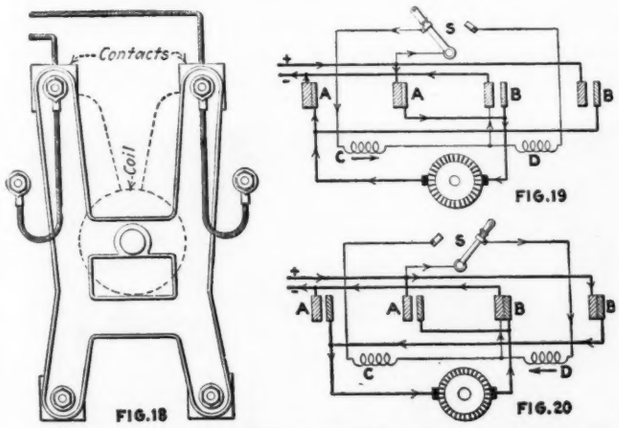


FIG. 18 FIG. 19 FIG. 20

FIGS. 18 TO 20. MAGNET-TYPE REVERSING SWITCHES THAT OPERATE HORIZONTALLY

Silencers on Semi-Diesel Engine Exhausts

Recent tests on semi-Diesel oil-engine exhausts indicate the unexpected fact that there are two separate noises in the exhaust of the internal-combustion engine. It appears that one noise is caused by the sudden release of the exhaust gases due to the lifting of the exhaust valve or the uncovering of the exhaust port, and that another and separate noise is caused by the discharge of the exhaust gases into the atmosphere from the end of the exhaust pipe. The former is very much the louder of the two noises. It possesses a sharp "bark" characteristic which has great carrying power and can be heard at a long distance. The discharge of the gases from the exhaust pipe, or the "puff" noise, is referred to as being more "soft" and does not carry so far.

The reason for the "bark" noise being so offensive is due to the fact that it represents much more energy than the "puff" noise and is concentrated in a much shorter period of time. The pressure of the exhaust gases at the completion of the exhaust stroke usually amounts to something in the vicinity of 40 lb. per sq.in. Liberating this pressure in a small fraction of a second creates a noise wave of great suddenness and also of great energy content. This wave, once created, is hard to dissipate, but it is stated that one make of silencer has been found equal to the task and is able not only to eliminate entirely the offensive character of the noise, but also to handle the "puff" noise. On a semi-Diesel oil engine the exhaust was turned into a soft pulse, which gives no offense and is not noticeable unless attention is directed to it.

Advantage may be taken of the venturi-tube principle in the construction of the silencer and the eddy losses in the gas flow should be small and the back pressure should not be raised to any noticeable degree.

Improvement of Power Factor

The subject of improving the power factor of induction motors was referred to the manufacturers by the N. E. L. A. Electrical Apparatus Committee, and according to the 1922 report their investigation of the subject for the committee is but just begun and may lead to conclusions differing from their present views. These are that the standard lines of motors now available have as high a power factor as is justified, when such other factors as cost and efficiency are given due weight in the design. Two methods of improving the power factor of induction motors are available: (1) Special compensated windings; (2) static condensers applied to individual motors.

The first method involves the use of commutator and brushes and reduces the output of a given frame size to approximately the next lower rating. For a given rating the cost must, therefore, include the larger frame, wound rotor and commutator, as against a simple squirrel-cage winding, materially increasing the cost over that of a standard motor.

The second method greatly increases the cost. Static condensers are estimated at $30 per kva. and a 10-hp. motor with static condensers would be doubled in price.

Distribution-system power factor may be improved by five methods, as summarized by one manufacturer.

1. Possible improvement in induction-motor design. This method utilizes too much material for small gain in power factor and does not give the ultimate results desired.

2. Development of new high power-factor motors. This is a possible field of development, but it is doubtful whether suitable motors will be obtained for general service.

3. Use of synchronous motors and condensers. In sizes of 50 hp. and below the cost is two to three times that of induction motors except for very low speeds, in which case a synchronous motor not only has a much better power factor than the corresponding induction motor, but costs less. In the larger sizes, where applicable, it is a very economical means of correcting power factor.

4. Use of phase advancers. These are suitable for use with slow-speed wound-rotor motors of 100 hp. or larger, when these motors, individually or combined, form a large part of the total load.

5. Use of static condensers. These are especially

desirable in plants using small motors and having no suitable load for large synchronous apparatus.

The use of centralized capacity in the form of static or synchronous condensers, and insistence on the part of power companies that motors on their lines be loaded on the average to 75 per cent or more of their rating, except in those cases where the starting-torque requirements govern the motor size, today seems the least expensive method of improving system power factor.

Germans Distill Tar from Coal While Burning Under Boiler

BY DR. ALFRED GRADENWITZ

On account of the scarcity of oil in Germany and the impracticability of importing foreign oils, German engineers are finding it worth while to extract the low-temperature tar from coal before using it for power and heating purposes.

There are three possible ways of doing this: First, by distilling the fuel in closed compartments by heating

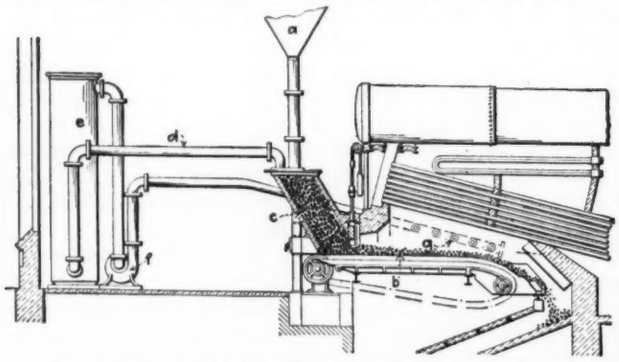


FIG. 1. DIAGRAMMATIC OUTLINE OF COMBINED FURNACE AND DISTILLATION PLANT

Distillation products are drawn off through the pipe d into the byproduct recovery apparatus e, where tar is extracted, and then returned to the furnace through burners g.

from the outside (the usual coking plant or gas works process); second, by gasifying the fuel in gas producers designed for the extraction of tar; and third, by burning the fuel in a grate furnace and distilling shaft arranged to combine the burning and distilling processes.

The last-named method is a new development that has been worked out by Bruno Meyer, chief engineer of Messrs. Julius Pintsch, Ltd., of Berlin. It is accomplished in a distinctly new type of furnace, which is shown diagrammatically in Fig. 1.

Before the coal in the bunker *a* reaches the grate *b*, it passes through a distilling shaft *c*. The coal in the bottom of this shaft is heated by the glowing coals on the front of the grate, and some of the gases given off are drawn though the pipe *d* into the extraction plant *e* by the pump *f*. The permanent combustion gases are then returned through the burners *g* into the furnace, the tar, ammoniac, etc., having been retained in the extraction plant.

Of course, all the gases extracted from the coal are not drawn through the distillation shaft; the operation is limited to a relatively small amount of combustion gases, of which, moreover, the greater part will be reduced to CO and H_2 (hydrogen) in the lower portion of the shaft under the influence of the incandescent carbon at the bottom. This gas mixture in the upper part of the shaft will become mixed with the distillation gases leaving the shaft at the top, without, however, destroying any valuable components (tar and ammoniac).

The advantages claimed for this method over the other two methods of distillation are as follows: When using coke prepared in coking ovens or gas retorts as fuel in furnaces considerable amounts of heat are lost in the cooling of the coke, after it is made and before it is burned, while in the present case any heat absorbed in the distilling shaft is restored to the furnace. In the case of gas-fired furnaces, any losses of heat in the gas producer are bound to add themselves to those of the furnace, thus increasing the consumption of fuel in proportion; moreover, the operation of gas producers, as a rule, is a rather complicated and expensive affair, since the uniformity of the fuel layer required for reducing the CO_2 and steam requires careful superintendence and, in the case of fuel containing a large percentage of ashes, a good deal of poking.

The new method was tried out for several months in an installation made by Messrs. Julius Pintsch, Ltd., in the municipal electric works at Lichtenberg, near Berlin. The equipment included a Steinmüller inclined water-tube boiler of about 5,400 sq.ft. of surface, with preheating and superheating. The installation is shown in Fig. 2. There were two traveling grates with a

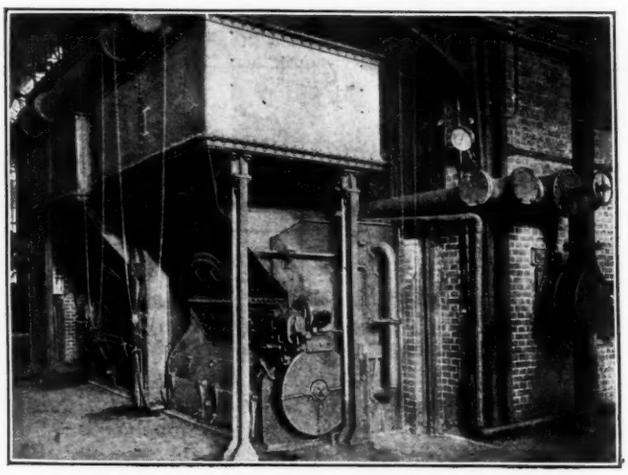


FIG. 2. INSTALLATION AT THE LICHTENBERG PLANT

At the right is one of the burners, at the top the suction pipe to the extraction plant, and in the center the two distilling shafts.

total surface of about 183 sq.ft. Two tests were run on this boiler, each lasting about 30 hours, one being without the tar plant and one with it. The percentage of fuel heat represented in evaporated steam was 76.8 in the former case and 77.5 in the latter. The gain in evaporation was apparently insignificant, but the dry tar output was 2.25 per cent, representing 4.3 per cent of the heat in the fuel and bringing the total efficiency of the boiler and distilling plant to 81.8 per cent.

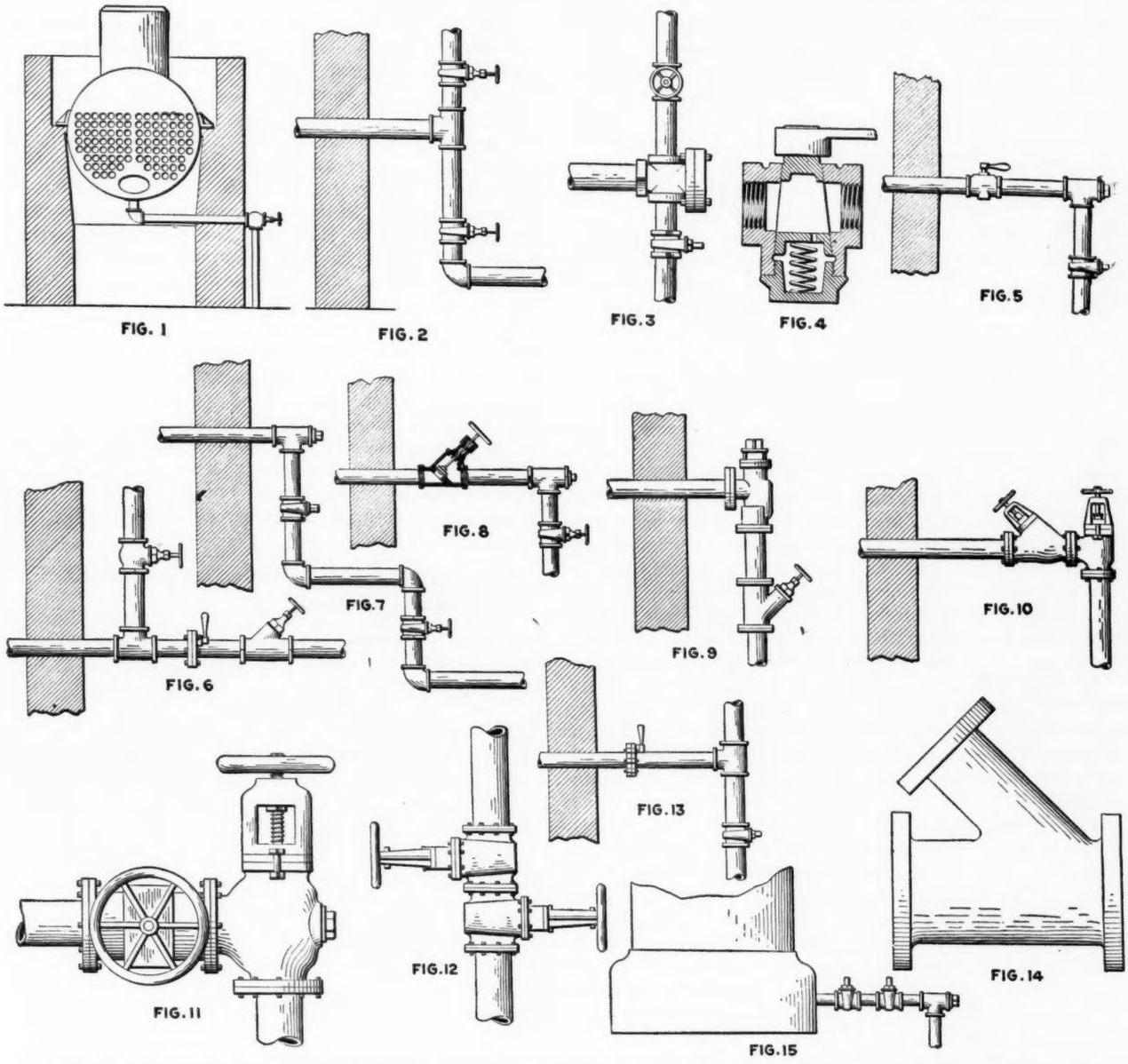
A comparatively small amount of distillation gas was drawn off in this test, but more recently, in the same installation, the tar output was raised to 5.53 per cent; and since that is twice 2.25 per cent, it should represent approximately twice 4.3, or 8.6 per cent of the heat in the fuel, indicating an over-all efficiency of perhaps 86 per cent.

Blowoff Valves and Connections

By W. H. WAKEMAN

A BLOWOFF valve and its connections that were formerly considered satisfactory are shown in Fig. 1. The angle valve was convenient to open and close, although it was seldom operated except when the boiler was emptied for inspection and cleaning. some cases it is still used, but extra heavy pipe is much safer, and is recommended.

An improvement over Fig. 1 is shown by Fig. 2, where a tee is installed on the horizontal pipe, into the top of which a feed pipe is connected; the lower part



FIGS. 1 TO 15. SHOWING DIFFERENT TYPES OF BLOWOFF VALVES AND METHODS OF CONNECTING TO BOILER

If a piece of scale was caught under the disk when closing the valve, thus causing a leak of more or less importance, the boiler was cooled off and all the water allowed to escape. The bonnet was then removed, and the disk and seat were inspected and repaired. It was also possible to insert a rod and remove scale that had lodged in the long horizontal pipe. The condition of the pipe could be ascertained. Ordinary pipe was formerly considered sufficient for this service, and in carries the blowoff pipe. A gate valve is shown on each. This arrangement is not the best that has been designed so far as the boiler is concerned, as the comparatively cool feed water is discharged directly on the lower sheet; nevertheless, it does protect the pipe from the intense heat of the products of combustion as they pass along on their way to the chimney or stack. This is more effective than any form of outside covering.

The next improvement consists of a cross instead of

the tee, thus enabling the engineer to remove a plug and gain access to the internal parts. Fig. 3 is a special fitting made for this purpose. One outlet is flanged and fitted with a blank flange that can be removed by taking out four bolts. The gate valve is retained for the feed pipe, but a plug cock is on the blowoff pipe. For this service an ordinary brass cock was formerly considered sufficient and is yet in some cases, but it is likely to stick so tight that the force required to open it is sufficient to endanger a weak pipe; hence it is unfit for such use.

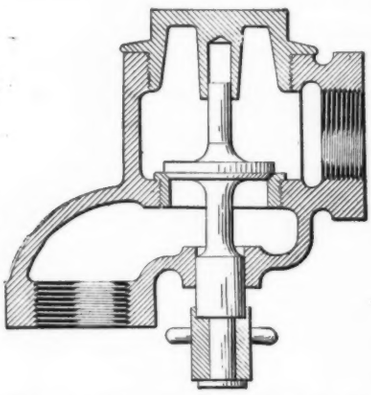


FIG. 16. THIS TYPE OF VALVE IS HELD CLOSED BY BOILER PRESSURE ONLY

Fig. 4 shows an improved cock for this service. Both plug and shell are made of iron with a screwed cap to cover the bottom of the plug. A spiral spring holds the plug to its seat, making it impossible for scale to become wedged in at this point and automatically taking up wear of the parts in contact. After much trouble with single valves on blowoff pipes, where a remedy could not be applied for leaks and obstructions until the boiler could be laid off for repairs, the plan of using two valves or cocks, or one valve and one cock, was presented and at once was favored by engineers. Fig. 5 illustrates a common cock in the horizontal pipe, and an asbestos-packed cock in the vertical. If the former cannot be closed on account of a piece of scale caught in the plug, the latter can be shut, thus preventing the escape of hot water until the boiler can be cooled off and the obstruction removed.

In some plants no definite rule is applied for operating these cocks, but either one is opened first or last, according to the caprice of the operator. Although opinions differ concerning the best rule to be adopted, all such operations should be conducted on a definite system.

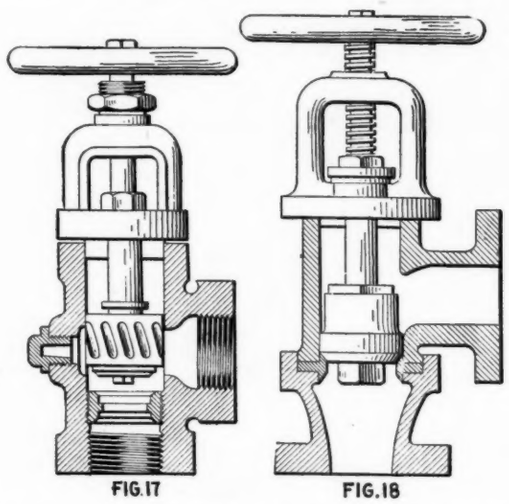
Fig. 6 illustrates a horizontal blowoff pipe that is near the floor. The vertical part is in the combustion chamber. The vertical pipe shown is an auxiliary feed pipe. A flat blowoff valve operated by a lever is next on the line, followed by a Y valve which shuts against the pressure. They are operated as follows: The Y valve is opened first, then the other is opened slowly, and when the desired quantity of water has escaped, it is closed, after which the Y valve is shut. This plant is operated continuously, hence there is no choice left to the engineer concerning the best time to blow down his boilers.

Fig. 7 shows a tee next to the boiler. Of course the plug in it cannot be taken out for cleaning purposes while the boiler is in service, but it is not necessary to do this, as taking it out when the boiler is laid off is sufficient. This is followed by an asbestos-packed plug cock. The next two ells seem to be superfluous, but they were used to pass by an obstruction, not shown. The gate valve is last, but it is opened first, and the blowing is done by slowly opening the cock. This is closed first, then the gate valve. This plant is operated about 16 hours per day, and the boilers are always blown down before the dampers are opened.

Fig. 8 shows a Y valve next to the boiler, which shuts against the pressure. It is shown in section, and it affords a nearly straight passage for water and sediment, but is not equal to a plug cock or a gate valve in this respect. It can be repaired at less expense than either. The plug in the tee can be removed at any time provided the valve is tight, but this is not an important consideration. The gate valve below it is opened first, then the Y valve. It is closed first and the gate valve last.

Fig. 9 is a unique feature as it shows an angle plug cock next to the boiler with a Y valve below it. The location of the latter causes it to shut with the pressure, or in other words when it is shut the pressure acts on top of the disk to hold it to its seat. This is a good feature so far as this particular point is concerned, but force must be exerted to lift it from its seat when opening it, and if the nut that attaches the stem to the disk becomes loosened or broken, no water can flow past it. However, the plug cock above it makes it possible to shut off the pressure and make repairs. If the Y valve is opened first and closed last, this objection does not apply, provided the cock is tight.

Fig. 10 shows a combination in which the Y valve is next to the boiler, hence pressure is on it as long as the boiler is in service. However, the manufacturers of these valves direct that the Y valve shall be opened first and the blowing down controlled by the angle valve. When enough water has escaped, the angle valve is closed first, then the other. This is different from the practice in many plants, but it has at least one important advantage. The wear affects the outer valve only, hence it can be repaired at any time, as the inner valve is assumed to retain its original condition and never leak.



FIGS. 17 AND 18. TYPES OF ANGLE BLOWOFF VALVES

Fig. 11 illustrates another special angle valve, with a gate valve between it and the boiler. This places the gate valve in a horizontal pipe, but it is more likely to retain scale in the pocket below the gate than if it were in a vertical pipe. However, placing the stem horizontal is a good feature.

The manufacturers of this combination recommend a still different plan for its operation. The gate valve is regarded as an emergency valve only, hence it is to

be always open while the boiler is in service, except when it is closed and directly opened once each day to insure its operation. In case the angle valve needs repairs, the gate valve will then be in good condition to shut off the pressure.

Fig. 12 shows two gate valves, and they can be located in a horizontal pipe if desired, but a vertical

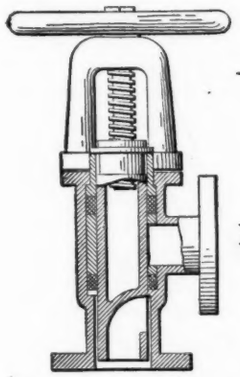


FIG. 19. PLUNGER TYPE OF BLOW-OFF VALVE

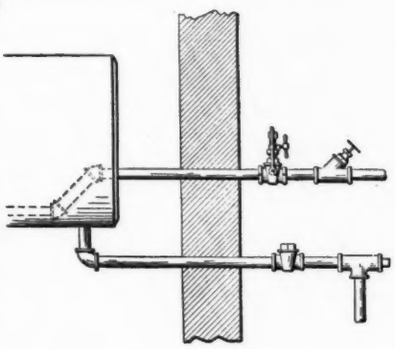


FIG. 20. SHOWING TWO BLOW-OFF CONNECTIONS ON ONE BOILER

pipe is better. Either one may be used first or last, according to the system adopted by the engineer.

Fig. 13 is a plan view, all piping being horizontal. A flat sliding valve is located next to the boiler, and it discharges through an ordinary tee into a main pipe line, and four similar valves discharge into the same line. The plug cock acts as a reserve for all five of them to prevent waste of hot water in case they leak. Instead of using the short tee as shown, it would be much better to substitute the fitting illustrated in Fig. 14, as it would eliminate the vibration caused by water under pressure making a right-angle turn.

While it is always desirable to have a tight blowoff valve on every boiler, the actual loss due to leaks at this point is greatly exaggerated. For illustration, it is claimed by some that if a blowoff valve leaks 2 cu.ft. of water per hour, it causes a loss of about 15 lb. of coal, or 360 lb. in 24 hours, assuming that one pound of coal evaporates 8⅓ lb. of water. This would be true if the water was evaporated and the steam lost, but it is not correct for ordinary conditions. Taking the initial temperature of water at 60 deg. and raising it to 325 deg. F. requires about 265 heat units per pound, or 33,125 for 2 cu.ft. If the coal contains 14,000 heat units, 10,000 are utilized in practice; the foregoing represents a loss of 33,125 ÷ 10,000 = 3.3 lb. per hour, or 79.2 lb. in 24 hours.

If the water that is blown out of this boiler goes directly to the atmosphere, some of it flashes into steam, due to reducing the boiling point from 325 to 212 deg. as the latent heat required to evaporate it has not been added, hence it cannot be lost through a leaky valve, but the heat required to heat the water from 60 to 325 deg. is lost.

Fig. 15 shows two asbestos-packed plug cocks on a vertical boiler. As they are alike, either one may be opened or closed first with equally good results. On one occasion a boiler of this type was drilled and tapped for a 2½-in. blowoff, but the owner desired to use a 2-in. pipe. He was advised to use a 2½-in. nipple, followed by a 2½ x 2-in. ell, as providing a safe combination, but he used a 2½ x 2-in. cast-iron bushing to reduce the size. This is dangerous, because a bushing that only reduces one size is not strong enough for high pressures, hence should not be used. The boiler inspector condemned it.

Plug cocks are not always favored by insurance companies, because a quick closing of the plug may produce a force sufficient to break a fitting. A gate valve is free from this objection, as it is not possible to close it rapidly.

Fig. 16 is a valve that is opened by applying a lever to the lower end of the stem, thus raising the valve from its seat. It is impossible to open this valve slowly, because the first practical movement gives nearly full capacity of the valve.

The valve shown by Fig. 17 is fitted with a deep disk holder which is milled as shown. When this disk is raised from its seat, it is rotated by the action of the water passing through the valve, thus preventing scale and sediment from collecting at this point. When closing the valve, the disk passes the opening before it comes in contact with the seat, hence the grinding process is automatic, and it prevents scale from being caught between the disk and the seat.

Fig. 18 illustrates an angle blowoff valve in which the escaping water is given a whirling motion that cleans the seat every time the valve is operated. This is secured by a deflector on one side of the port, and as this action prevents water from striking at right angles to the body of the valve, it modifies the vibration of the piping.

Fig. 19 is a blowoff valve without a seat, as it consists of what is practically a plunger moving in a cylinder. A packing ring is located above and below the port opening when the valve is closed, and as these are compressed by closing the valve, they prevent water from passing upward through the bonnet and downward to the blowoff pipe without depending on the seating of a disk. When the valve is partly or wholly open, this packing is only held lightly in place, therefore it does not wear rapidly.

Fig. 20 shows two sets of blowoff connections fitted to one tubular boiler. The lower device is of ordinary design, controlled by a plug cock. The upper one is a peculiar feature, as it extends through the rear head, then by two 45-deg. ells it is carried to within two inches of the bottom sheet, nearly to the front head. This pipe is perforated throughout its length. The first valve is of the quick-opening type, as the stem slides in the bonnet and stuffing box. The second is the regular Y valve. The latter is opened first, then the former is lifted by a lever movement to its full capacity as quickly as possible. The sudden disturbance of the sediment causes it to be forced through the numerous holes to the sewer. To reverse the position of these valves would be an improvement, because the present arrangement brings the valve that is most likely to be worn by scale and sediment passing through it, next to the boiler where it can be repaired only when the boiler is laid off. The Y valve would be wide open when water is passing through it, hence would not be subjected to wiredrawing, which causes rapid wear. When this is shut, the other could be repaired without further trouble. The lower connection is used only when all the water is to be removed for inspection of the boiler.

Too much attention cannot be given to installation of blowoff valves and their connections, and the general rule of one valve and one cock for pressure over 100 lb. should be followed whenever possible.

Determining Pounds of Coal and B.t.u. per Kilowatt-Hour

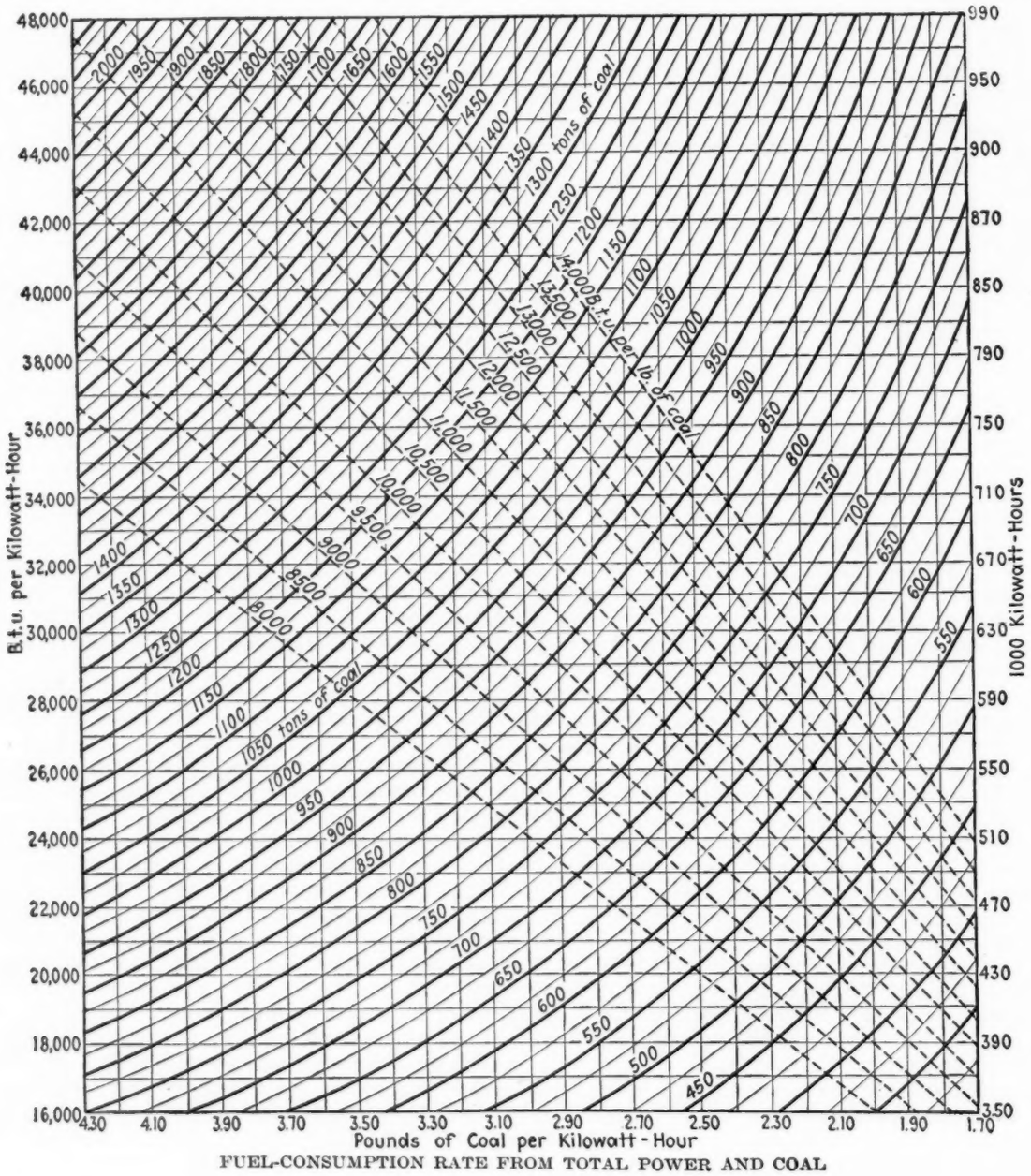
By E. L. MacDonald*

The accompanying chart will prove a convenient short cut in figuring the daily rate of fuel consumption for the station. In the average plant where these computations must be made, the usual procedure is to multiply the tons of coal by 2,000 to convert to pounds and then divide the result by net or generated output in kilowatt-hours, or by both. This gives the pounds of coal per kilowatt-hour, and when the B.t.u. for the same electrical unit is desired, another computation must be made, all of which takes time.

Start with the kilowatt-hour output at the right, then move horizontally across until the line giving the number of tons of coal is intersected. Drop to the bottom of the chart and read directly the pounds of coal per kilowatt-hour. To get the B.t.u. per kilowatt-hour, drop or rise from the previous intersection to the line indicating the B.t.u. per pound of coal and then move horizontally to the scale at the left of the chart and read the B.t.u. per kilowatt-hour.

Suppose a plant generated 710,000 kw.-hr. within a certain period on 1,400 tons of coal having an average heat value of 10,000 B.t.u. per pound. Find the intersection between the horizontal 710,000-kw.-hr. line and the inclined 1,400-ton line. To get the pounds of coal per kilowatt-hour, dropping from the intersection vertically downward to the bottom of the chart will give 3.95. To find the B.t.u. per kilowatt-hour, rise vertically from the initial intersection to the 10,000 B.t.u. line and then move horizontally to the left to obtain 39,500 B.t.u.

The range covered by the chart will apply to the majority of generating stations using a wide variety of coal.



FUEL-CONSUMPTION RATE FROM TOTAL POWER AND COAL

*Combustion engineer, Kansas City Power and Light Company.

How Hot Does a Bearing Run?

BY W. F. OSBORNE
Supervisor Manufacturers' Service, Texas Company

THE temperature of a bearing is different in almost every part of it, and the point where the temperature is measured and the method of measuring it have everything in the world to do with accurate and consistent results. The temperature may be ten or fifteen degrees higher at one end than at the other, owing to conduction of heat, as from a steam-turbine casing or an electric-motor armature. Probably it will be cooler at the top of a bearing than at the bottom, because the clearance is larger there and the frictional resistance is less. Furthermore, the fresh cool oil usually comes in at the top and the hot oil leaves at the ends, most of it from the lower half. The exit side of the bearing will be hotter than the side at which the oil enters.

The question to be decided, is, Of what substance do we want to know the temperature and at what point?

HOW hot is a bearing? We frequently hear someone say that such and such a bearing runs at 125 deg. F. or 173 deg. F. or some other temperature. Then another engineer says that he has the same kind of a machine, but that he cannot get the bearing temperatures down below 135 deg. or 180 deg. F., as the case may be. Then, just to see what the trouble is, we go and stick a thermometer in both bearings and we get a set of readings that are entirely different. What is the trouble? Have the conditions changed? Are our thermometers wrong? Do we know how to take a bearing temperature anyway?

Evidently, the point of danger from failure of the oil film is at the point of least clearance. Any serious increase in temperature at this point might reduce the viscosity of the oil to such an extent that the film would break and metal-to-metal contact would result. Again, any increase in friction would show up here first, by a rise in the temperature of the oil and of the metal. Apparently, then, the best place to measure is here, at the point of least clearance.

If we are interested in temperature from the standpoint of possible failure of the oil film, evidently we should measure the temperature of the oil at this point. If we are concerned about the softening of the bearing metal through excessive heat, we should measure the temperature of the metal itself at this point.

The measurement of the temperature of the extremely thin oil film or of the inner surface of the bearing metal is a very difficult job. For practical purposes probably the best method is to insert a thermocouple in the bearing at the point of least clearance so that the couple will be just below the inner surface of the bearing. If a thermocouple is not available, a hole can be drilled down close to the bearing surface somewhat as shown in the illustration. A small amount of mercury may be placed in the bottom of the hole and an ordinary thermometer immersed in the mercury. Either method will measure a temperature somewhat less than that of the oil film or of the surface of the bearing metal, but the results should be comparative to a reasonable degree of accuracy.

If the point of least clearance cannot be determined accurately, a point forty-five degrees up from the bottom of the bearing on its approach side will give fairly accurate results. If the point of least clearance shifts, owing to loads, a change in the viscosity of the oil or for any other reason, the fact will be readily noticeable in the changed temperature reading.

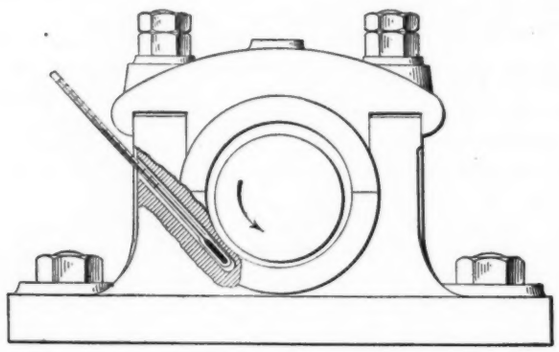
There are many large bearings in power plants whose failure would result in expensive repairs or loss of money due to a shutdown of the machinery and it would be money well spent to equip such bearings with recording thermocouples. In this way any undue rise of temperature could be detected and proper measures taken to prevent trouble.

There are many other ways of taking bearing temperatures, which are not always comparable and frequently do not measure anything of value at all. For instance, common practice is to stick a thermometer in a hole in the top of the bearing cap, resting the bulb of the thermometer on the rotating shaft. The extreme end of the bulb is influenced by the temperature of the shaft, and most of the bulb is partly immersed in a bath of oil. In some bearings the only oil that gets on the thermometer is that which is scraped off the shaft. In others the supply of fresh oil passes over the thermometer on its way to the bearing. In such a case the thermometer will measure the temperature of the fresh oil and will probably be quite uninfluenced by the actual temperature of the oil film or the shaft. Another way is to measure the temperature of the oil leaving the bearing. If the bearing is so constructed that all the oil leaves from the ends of the bearing, and the thermometer can be placed directly in the path of this oil just as it leaves the clearance space, it is possible that results that will be comparative may be secured. When the quantity of oil supplied to the bearing is so large that part of it flows over the outside of the bearing shell, the temperature of the outgoing oil evidently would have very little in common with the temperature in the clearance space.

One way of determining the relative value of two oils as far as frictional heat is concerned, is to compare the amount of heat absorbed by the oil flowing through the bearing and that taken up by the jacket water. By measuring the quantity of oil flowing to the bearing per minute, the temperature of the oil just before it enters the bearing and just after it leaves, the quantity of heat absorbed can be readily calculated. The same measurements can be taken in the case of the cooling water. If conditions are such that we can assume that conduction of heat to or from the bearing by the atmosphere or other parts of the machine is constant, these figures will give us a comparative idea of the value of the two oils in reducing friction.

Since viscosity is probably the all important physical property of an oil in the formation of a lubricating film, with the possible assistance of the surface tension

or adhesiveness of the oil, and because the viscosity of every oil changes quite rapidly with the temperature, we can readily see what an important thing it is to know the actual temperature to which the oil will be subjected. If the operating temperature is underestimated, the oil that is selected may be too light in



PROPER LOCATION OF THERMOMETER IN A BEARING

viscosity at the actual operating temperatures, and trouble will result from lack of sufficient lubricant.

If the temperature is over-estimated, the viscosity selected for the high temperature will be too great for the actual temperature and unnecessary friction losses will occur. Evidently we should know as closely as we can the true temperature of the oil film—not only for the selection of oils, but for comparing the results of two oils in service.

Coleman Refrigeration Control

To supply the need of an automatic control for small refrigerating machines, whereby the storage temperature might be held constant, the Coleman Electrical Manufacturing Co., Rising Sun, Ind., has developed the control shown. The device consists of a toggle electric switch, magnetic operated condensing-water valve, protector for the discharge lines and a refrigerator thermostat.

The switch is electrically operated by a very small current controlled by the high-pressure and thermostat elements. The arrangement is such that the operating current is on only momentarily, yet there are no auxiliary contacts, neither do the sensitive elements break any current at any time. All intricate parts are avoided by the method of connection. The contacts are locked home under heavy pressure by a toggle. The break is unusually fast. Auxiliary arcing contacts are provided. It will operate on single-phase, three-phase or direct current.

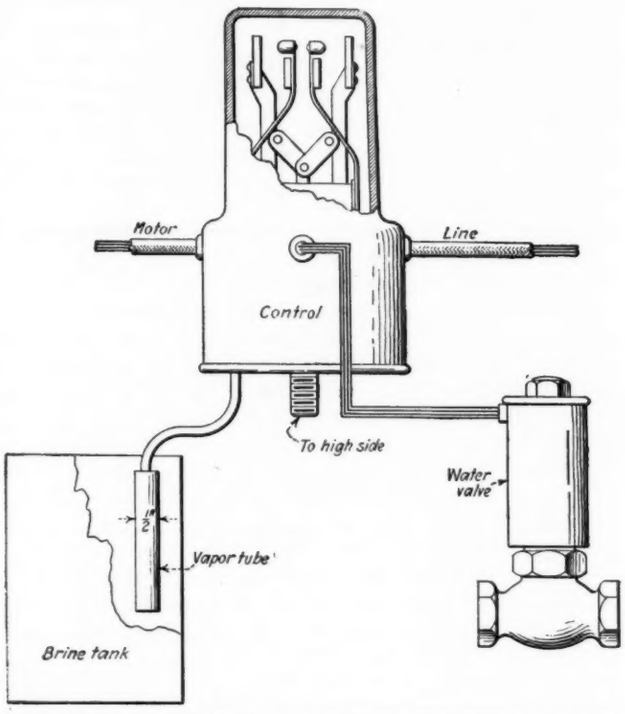
The thermostat consists of a Bourdon tube mounted on the switch and connected to a vapor bulb, which may be placed in the refrigerating room. The vapor-tube thermostat avoids wiring and insulating difficulties encountered when an unprotected thermostat of the metallic type is located in the refrigerator, where it is frequently subjected to excessive moisture. It is hermetically sealed and cannot be injured by corrosion. Being only ½ in. in diameter by 4 in. long, it can readily be inserted into a refrigerator through a ½-in. hole.

A Bourdon tube mounted on the switch acts as a protector for the high-pressure side and is arranged to trip the switch at a predetermined pressure. It is connected so that the thermostat cannot close the switch while the excessive pressure prevails, yet it can open the switch regardless of condenser pressure.

The water valve is a globe valve magnetically operated. It is simple in construction, has only one moving part and no stuffing boxes or glands. The valve body and magnet housing are joined by a ground brass union, so they may be easily separated without twisting the wires or destroying any packing. The wire leads from the valve are of distinctive colors and connect to similar colors on the switch. This is of great advantage where conduit or similar wiring requirements are encountered.

The switch and Bourdon tubes are inclosed in a cast aluminum case about 4½ in. in diameter at the base reducing to 3 in. at the top and 7 in. high. This case has no opening except a hole (closed with a cap plug) to reach the temperature adjustment. Provision is made to seal the case so the user cannot tamper with the control. This has been of great advantage in other devices going to the domestic user. The water valve is entirely self-inclosed.

The operation is as follows: When the refrigerator reaches the predetermined high temperature, the thermostat closes the circuit of the switch. The switch in closing starts the motor and also opens the water valve supplying water to the condenser. When the refrigerator reaches the predetermined low temperature, the thermostat makes the opening circuit of the switch and the operations are reversed. If excessive



AUTOMATIC CONTROL FOR REFRIGERATING SYSTEMS

pressures are developed in the high side of the machine, due to water failure or any other cause, the high-pressure device makes the opening circuit of the switch and stops the machine.

The influence of clearance in ammonia compressors is not so detrimental to the efficiency of a compressor as has been claimed. It is, however, very detrimental to the capacity of the compressor.

Outline of the Absorption Refrigerating System

Discussion of the Functions of the Several Parts—Cycle of Events in the System—Operating Procedure To Be Followed

BY D. L. FAGNAN

A COMPLETE absorption system consists essentially of the following parts, all interconnected to form an efficiently working system: (1) Generator; (2) analyzer (in some systems the analyzer has been left out, a dry gas header in the generator taking its place); (3) rectifier or dehydrater; (4) ammonia condenser; (5) anhydrous liquid receiver; (6) strong aqua ammonia receiver (not shown in the illustrations); (7) brine cooler or direct expansion piping; (8) absorber; (9) ammonia pump; (10) heat exchanger; (11) weak-liquor cooler. These several vessels are connected together with all necessary piping and valves for properly regulating the steam supply, for the feed of liquid ammonia to the brine cooler or direct-expansion piping and for the return of the strong aqua ammonia from the aqua receiver back through the heat exchanger to the generator.

There have been developed four distinct types of absorption refrigerating and ice-making machines—shell, tubular, double-pipe and atmospheric. These names are derived from the kind of condensers used, and each has its advantages over others for particular conditions. For instance, where water is very bad, the atmospheric type throughout would preferably be chosen. A careful study of conditions obtaining will determine the type to install.

OPERATION OF THE ABSORPTION SYSTEM

The exhaust-steam absorption system is particularly advantageous where reciprocating engines are in use and the exhaust steam from the engine is available, for under these conditions the fuel cost is practically nothing, the condensate from the generator being available for feeding to the boilers, provided a good efficient oil separator is used in the steam line going to the generator for it is necessary to have clean steam.

The generator is filled with sufficient aqua ammonia (which is a solution of anhydrous ammonia and water) to cover the steam coils, the correct level being about one inch below the top of the gage glass, after the absorber and aqua receiver have their usual supply. During normal operation steam heat drives off the ammonia vapor, which is enriched by the rich liquor entering from the analyzer. The gas passes up through the analyzer (2) to the rectifier coil (3) to be free there of its water vapor, which is carried along with the ammonia vapor, and then continues on to the condenser (4) where it is liquefied. The now pure anhydrous ammonia flows to the liquid receiver (5). From here it passes through the regulating (or expansion) valve to the brine cooler (7) or direct-expansion coils, where it is evaporated into gas by the absorption of heat from the circulating brine or from the room contents. The gas passes to the absorber (8), where it is absorbed by the weak liquor, which has come from the generator. This enriches the weak liquor, which, after flowing into the aqua receiver is picked up by the aqua pump (9) and forced through the exchanger (10) and the analyzer back into the generator (1) again. This is the regular cycle and continues as long as the plant is in operation.

THE DIFFERENT PARTS AND HOW THEY SERVE

A description of each part of the complete plant follows and how it serves in the running of the plant and why are explained.

The *generator* is a long cylindrical container, which in small sizes is built of cast iron very heavy throughout and in large sizes of steel plate, and provided with either steam coils or expanded tubes of heavy gage. The generator is filled with sufficient aqua ammonia to cover the top steam coils to a depth of about 2 inches.

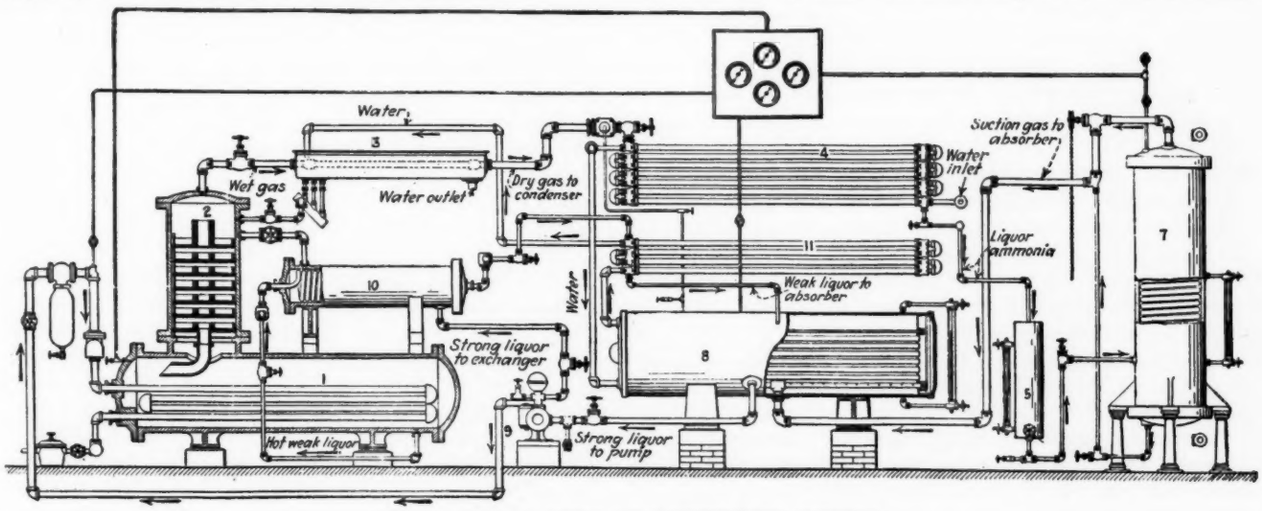


FIG. 1. SHELL TYPE OF ABSORPTION SYSTEM

The anhydrous ammonia is generated from aqua ammonia, which is a mixture of water and anhydrous ammonia, by the application of either live or exhaust steam. The exhaust steam is preferable, and any pressure can be used; low pressures require more coil surface in the generator and a stronger concentration is necessary, for the degree of concentration at which gassing ceases depends on the temperature in the generator. The distillation of the ammonia creates a pressure within the generator sufficient to cause a gas flow to the analyzer.

The *analyzer* is the vertical dome directly on top of the generator, forming an integral part of it. It contains a series of pans or plates over which the strong aqua ammonia is delivered by the ammonia pump. It is the apparatus in which the outgoing ammonia vapor is enriched by intermingling with the incoming aqua ammonia, which upon mixing with the warm vapor gives up part of its ammonia before reaching the generator. The series of pans and plates also serve the purpose of separating some of the moisture that would pass over with the ammonia on its way to the dehydrater, or rectifier.

The *rectifier*, or *dehydrater*, is the apparatus in which the ammonia vapor is freed of any water that may have been carried over with the gas, and the latter is rendered practically anhydrous—that is, free from water. If any water vapor enters the ammonia condenser and the liquid ammonia receiver, it will cause trouble by raising the condenser pressure, requiring a higher generator temperature. To secure the best results, the anhydrous received should be kept free from moisture. The proper low boiling point can be obtained only if the ammonia is pure and dry when it enters the condenser. In operating the plant, the drip valve from the rectifier should be kept open, as should also the valve at the generator, to allow all moisture and poor liquor to return directly to the generator as fast as formed.

The mission of the *condenser* is to liquefy the ammonia gas flowing into it, by allowing the heat in the gas to be absorbed by cooling water. The liquid ammonia passes to the liquid receiver and from there to the regulating or expansion valves to be re-evaporated into a gas and provide the necessary cooling work of the machine.

In the shell and coil condenser, the water flows through the various helical coils, while the gaseous ammonia enters the top of the shell, is cooled, condensed and leaves as a liquid from the bottom of the shell.

In the double-pipe condenser the gaseous ammonia enters the annular space between the inner and outer pipes while the water flows through the inner pipe. The ammonia passes through the coil, is cooled, condensed and leaves in liquid form from the bottom of the condenser.

In the atmospheric condenser the ammonia passes through the interior of the pipe, while the water flows over the outside.

The *liquid receiver* is a reservoir for the liquefied anhydrous ammonia. It allows liquid to be sent to the regulating or expansion valves at a rate faster than the normal condensing capacity whenever this is necessary, and accumulates liquid if it is not immediately needed in the evaporating coils. If an operator desires to get the best results from any type of refrigerating machine, it is imperative that he maintain a liquid seal in the receiver—that is, keep 12 to 16 in. of ammonia showing in the receiver glass to prevent gas from passing through the regulating valves. To skimp on ammonia is nothing short of criminal, for the plant capacity drops enormously, while the amount of steam used to operate the plant does not change. The coal bill is just as high as if the plant were operating with a full charge of ammonia, but the work done by the machine is reduced materially, so one should never operate any longer than necessary with a short charge of ammonia.

The *strong aqua ammonia receiver* is a tank built of heavy steel plate, tested to 250 lb. or more, and has a gage glass and valves of self-closing type to show the liquid level and receives the strong aqua from absorbers and serves as a reservoir to hold temporarily, as when pumping out, the strong aqua on its way to the ammonia pump. This is not always used and does not appear in the illustrations.

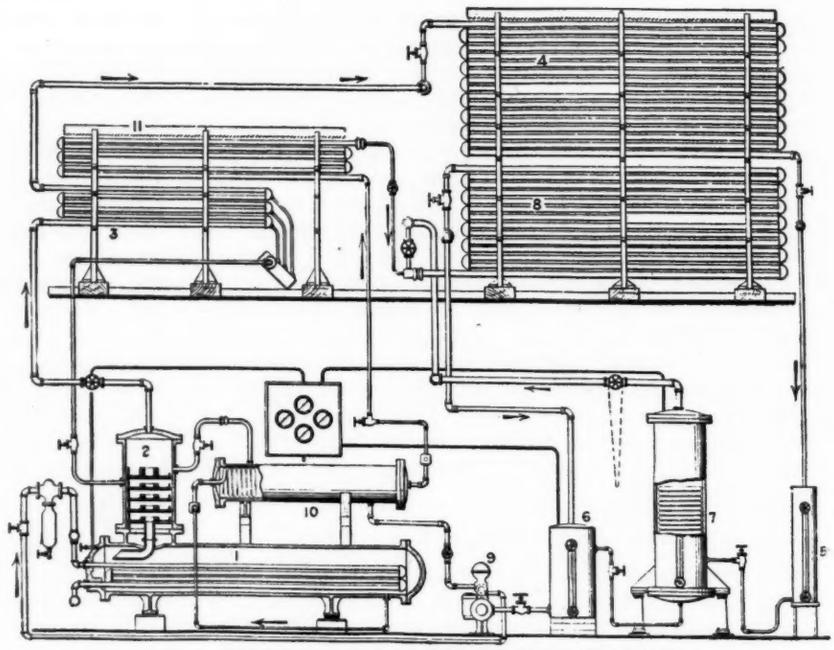


FIG. 2. SYSTEM USING ATMOSPHERIC CONDENSERS

The *brine cooler* is the place where the refrigeration is being effected. The greater the heat absorbing surface in this part of the system, the more economical will it work because a small difference in temperature between ammonia and brine or air will then suffice.

The brine cooler, when used, works on the so-called flooded system, the liquid-ammonia level being carried a little higher than the upper gage cock. When the frost line thaws, the liquid is entirely too low and the regulating valve should be opened a little more. On the other hand, the brine cooler should never be operated with frost forming on the purge pipe. This is wasteful and shows a too high liquid level, and it will be found that instead of the brine going lower it is actually rising during operation, hence the expansion valve should be checked a trifle and the difference in

cooling noted. Frost should never be allowed to cover the gas header valves over the absorbers. A wet or dripping header is best.

The *absorber* is the apparatus in which the ammonia vapor is absorbed by the weak liquor, thus forming strong aqua ammonia, usually called rich liquor. In the shell and coil absorber, the water flows through the various helical coils, while the ammonia gas from the brine cooler or expansion coils enters the upper part of the shell. Here it comes in contact with weak aqua ammonia liquor entering through a spray in the top head of the absorber. As the weak aqua passes downward through the shell around the coils, the ammonia gas coming from the coils is absorbed by the weak liquor and the resultant mixture leaves the bottom of the shell as strong aqua ammonia liquor.

In the atmospheric and the double-pipe types of absorber the gas from the brine cooler or expansion coils enters the suction chamber of an injector fitting and the cool weak liquor is admitted through the jet of the injector. The resultant mixture passes, in the case of the double-pipe absorber, through the annular space between the two pipes. The water, in the case of the atmospheric absorber, flows over the outside pipe, while in the double-pipe absorber it flows through the inner pipe.

The *ammonia pump* (which is generally float controlled) takes the cool rich liquor from the aqua ammonia receiver and forces it through the exchanger into the generator.

The *heat exchanger* is the apparatus in which a transfer of heat takes place between the weak aqua leaving the generator, which is normally at a temperature above the boiling point of water, and the strong aqua from the absorber on its way to the generator. For reasons of heat economy it is necessary to elevate the temperature of the cold rich liquor as much as possible before it enters the generator. The weak liquor leaves the generator hot, and must be cooled before reaching the absorber to enable it to absorb its full proportion of ammonia vapor, since its power of absorption depends on the temperature. For this reason a system of piping employing the counter-current principle is installed, whereby the hot weak liquor gives up some of its heat to the cold rich liquor. In this way much heat is reclaimed that would otherwise be lost, also the amount of cooling water to be pumped is reduced.

The *weak-liquor cooler*, or weak aqua cooler, is the apparatus used to remove still more heat from the weak liquor on its way from the generator to the absorber.

For highest efficiency the entire pipe system should be neatly connected and properly valved to facilitate pumping out and repairing as well as replacing of gaskets without undue loss of contents, all valves being properly packed against leakage at the stuffing boxes. In many absorption plants poor results are obtained because of leaky valve stems on the piping leading to or from the absorber. These leaks admit air when producing low brine temperatures owing to the vacuum required in the absorber. Even with 1 or 2 lb. gage pressure in the absorber, a certain amount of air enters through leaky valve stems. The ammonia rod packing, if not in good condition, will admit air which is forced into the generator and raises the head pressure. This air must be purged to the absorber and thence removed to restore normal conditions.

As it takes but little air to retard materially the action of the absorber, poor results must be expected. The remedy is to purge the absorber of air and foul gases; but in purging there results some loss of ammonia, no matter how careful the operator may handle the plant. It is best to keep all valve stems, ammonia piston-rod stuffing box and all other parts of the system properly packed, in order that the system will work properly and efficiently.

For many years in low-temperature work the absorption system was in a class by itself. It had no competition. But of late the compound compression system has been so developed and so many refinements brought about that it has become a serious competitor, and it is a question as to which is the most economical or proper system to install. There is no question that the absorption system is best where there is exhaust steam at low pressure available in sufficient quantities to deliver the rated capacity of the machine, which is about 30 lb. steam per ton for zero degrees brine, increasing with a lower brine temperature, being 34 lb. for 10 deg. brine. However, the temperature of the condensing water is a factor to be considered and that is a subject too broad for this discussion.

Operation of Auto-Transformers

In what is known as a static or potential transformer there are two windings on a common core, as in Fig. 1, with no electrical connection between the two windings. However, if an alternating voltage is applied to the terminals of one winding, a current will be caused to flow in this winding, which will magnetize the iron core. Since the current is alternating in the coil, the magnetic flux in the core will be alternating. The magnetic flux alternating back and forth through the other coil

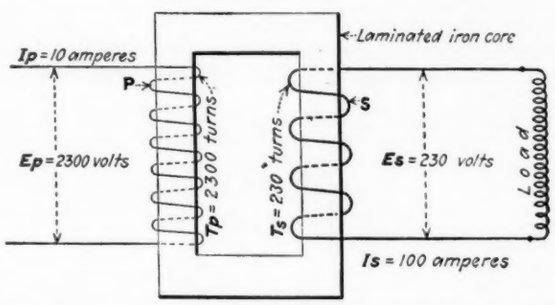


FIG. 1. SCHEMATIC DIAGRAM OF A SIMPLE STATIC TRANSFORMER

on the core will produce a voltage in it. The value of this voltage will depend on the relation between the turns in the two coils. If they both have the same number of turns, the voltage in each will be of equal value. If one coil has ten times as many turns as the other, the voltage in the coil with the high number of turns will be ten times that in the coil with the low number of turns.

The foregoing is shown in Fig. 1. Here it is assumed that the coil on the left has 2,300 turns and the one on the right has 230, or coil *P* has 10 times the number of turns that coil *S* has. If coil *P* is connected to a 2,300-volt line, there will be induced in coil *S* $\frac{1}{10}$ of 2,300 volts, or 230. On the other hand, if 230 volts is applied to the terminals of coil *S*, there will be 2,300 volts produced in coil *P*. In the former the device would be called a step-down transformer, and in the latter a

step-up transformer. With regard to the current the reverse is true of the voltage; namely, if 10 amperes is flowing in the 2,300-volt coil, 100 amperes will flow in the load connected to the 230-volt coil. The coil to which voltage is applied is known as the primary, and the coil in which voltage is induced is called the secondary. In the figure, on the primary side the watts, W_p equals volts E_p, times the amperes, I_p; that is, $W_p = E_p I_p = 2{,}300 \times 10 = 23{,}000$. Likewise, on the secondary side the watts W_s equals the volts E_s times I_s; that is, $W_s = E_s \times I_s = 230 \times 100 = 23{,}000$, as for the primary side. However, this condition can exist only in the ideal transformer; that is, one without any losses, which, of course, is an impossibility. In practice the losses are from 10 per cent on very small transformers to less than 2 per cent on large units.

In a large percentage of all starters for alternating-current motors the line voltage is stepped down through what is known as an auto-transformer. In this type one coil only is used for both primary and secondary winding, as shown in Fig. 2. In the figure with no load on the transformer, the total winding is the primary and the section between B and C is the secondary. With the primary connected to the line a small current, known as a magnetizing current, will flow from B to A or from A to B, depending on the polarity of the line from instant to instant. If tap C is made at the middle point of the winding, the voltage between points C and B will be one-half that between A and B; that is, if 230 volts is applied across A and B, 115 volts will be obtained between C and B for starting the motor.

If a load is connected to terminals $C\,B$, as in Fig. 3, then the load becomes part of the primary winding and the section of the transformer coil between C and B will act as the secondary winding. The primary circuit will then be from B through the motor winding to C and through the transformer coil to A.

Assume that 10 amperes flows from the line to the motor. This current at a given instant will flow from

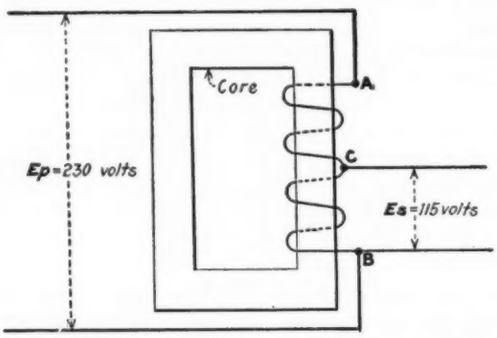


FIG. 2. SCHEMATIC DIAGRAM OF AN AUTO TRANSFORMER WITHOUT LOAD

terminal B through the motor windings to terminal C, then through the upper section of the winding to terminal A and back to the line. This current flowing in the upper half of the winding will induce in the lower half a voltage opposite to that in the upper half, which will also cause a current to flow through the motor. The direction of this current will be from the B terminal through the motor, back to the C terminal and down through the bottom half of the winding. In this we have a condition similar to the transformer in Fig. 1; namely, the secondary volts and current are in an opposite direction through the secondary winding, to that in the primary winding. Theoretically, the ampere-turns in the secondary winding should equal the ampere-turns in the primary. Since, in Fig. 3, the turns in the section of the transformer winding acting as the secondary has the same number of turns as the section acting as the primary, the current in both sections must be equal; that is, the amperes-times turns must be equal. Therefore, as 10 amperes flows from C to A, 10 amperes must flow from C to B. This current combines with

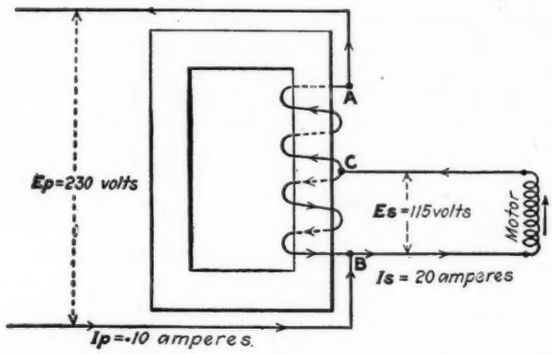


FIG. 3. SCHEMATIC DIAGRAM OF AN AUTO-TRANSFORMER CONNECTED TO LOAD

the primary current and flows from B through the motor winding back to C. With this combination it will be seen that only 10 amperes is taken from the line at 230 volts and 20 amperes supplied to the motors at 115 volts.

Any ratio of primary and secondary volts and current can be obtained by shifting the location of tap C. Where auto-transformers are used for starting induction motors, the secondary volts are made from 40 to 85 per cent of the primary volts. Taps are usually brought out on the winding to give three or four different voltages between this range, and the tap used that will give the most satisfactory starting voltage for the conditions under which the motor operates.

Although auto-transformers are cheaper to construct than the type with separate primary and secondary coils, the high-voltage and low-voltage circuits are connected together. In general, where the change of voltage is only 1 to 2 or 1 to 3, having the two windings connected electrically is not a serious objection. However, where a high voltage is transformed into a low, such as from 2,300 to 230, as in Fig. 1, it is desirable to have the two windings insulated from each other, both from a safety point of view and also to reduce the cost of insulating the low-voltage equipment. The latter having a direct connection to the high-voltage system will have to be insulated for this voltage, even though the operating voltage is low.

The Bureau of Standards is carrying out an investigation of the possibilities of increasing the quantity of used lubricating oil that may be reclaimed. Experiments with a commercial type of oil reclaimer, which involved increasing the temperature at which the oil was allowed to stand from 180 to 200 deg. F., increased the amount of oil recovered from 80 to 89 per cent. The data obtained show that the reclaimed oil is similar to new oil except with regard to sediment. Satisfactory means for the removal of this sediment, which is probably carbon, requires further investigation. In this connection it should be borne in mind that this increase in oil recovered may represent an increase in quantity at the expense of quality.

EDITORIALS

Superheated Steam for Process Work

SATURATED steam is one of the most effective agents for the transfer of heat, for the simple reason that it gives up a large proportion of its heat (measured above that in the feed water) with remarkable ease and without appreciable drop in temperature. Both its total cost and the total heat it contains are but little affected by variations of pressure within commercial limits. The net cost for process work, however, is directly dependent on the pressure wherever it is feasible to use a pressure drop for the generation of power, because the value of the power produced can be subtracted from the first cost of the steam. In such cases a large saving is made by using exhaust steam at the lowest suitable pressure.

However, the temperature, and hence the pressure, of saturated steam required for any process is ordinarily more or less fixed by the nature of the process itself. Certain processes require a steam temperature considerably above 212 degrees, with the result that saturated steam, if used, must come either from engines operating at high back pressure and correspondingly high steam consumption, or else directly from the boilers without the recovery of any "byproduct" power whatsoever.

For such processes, as well as for those requiring temperatures above that of saturated steam at the highest commercial pressure, superheated steam is finding considerable application.

There are, of course, certain limitations to the use of superheated steam in process work. Most of these are based on the fact that superheated steam can give up heat only by falling in temperature at the rate of about two degrees for every heat unit per pound that it gives up, whereas saturated steam gives up approximately one thousand British thermal units per pound in the mere process of condensing without loss of temperature. If live steam were specially generated and superheated for process work alone, and then exhausted from the process without being allowed to condense, only about ten per cent of the heat in the fuel would be utilized and the cost would in nearly all cases be prohibitive.

Granting these facts, it should be noted that there are many conditions under which superheated steam may be used with advantage. For example, high-pressure superheated steam may be supplied to process coils and afterward used to operate engines or turbines. Another field of application occurs where an excess of saturated exhaust steam is available. It may prove to be cheaper to superheat some of this for high-temperature process work than to generate a smaller amount of high-pressure steam. This arrangement should be particularly useful where the exhaust from the high-temperature process can be used for other process work requiring a much larger quantity of heat but at saturation temperature. Such an application is described on page 965 of this issue.

Again, there are some processes, particularly those involving drying, where it is possible to apply the counter-current principle. It frequently happens that most of the drying can be done at a moderate temperature, but that it is necessary to supply a relatively small amount of heat at high temperature to remove the last traces of moisture without slowing down the process. Such a problem might be economically solved by the use of superheated steam, particularly if the amount of heat usable at saturation temperature were from five to ten times that needed at higher temperatures.

Superheated process steam has already been applied in a number of industries. Among these may be mentioned the following: Pulp mills—cookers and digesters; rubber factories—vulcanizing; oil refineries—operation of stills; gas works—"blowing" water-gas generators; textile plants—boiling, drying, etc.; sugar refineries; salt works, etc.

The field is full of possibilities, but it is to be hoped that installations of this type will not be made without the active co-operation of engineers who have a thorough practical and scientific knowledge of superheated steam; otherwise the failure of ill-advised attempts may give a bad name to the whole subject.

Applications of Induction Motors Not a Simple Problem

ON ACCOUNT of its substantial and simple construction the squirrel-cage-type induction motor is a desirable machine for industrial purposes. However, there are many other characteristics that must be incorporated in the ideal machine, such as high starting torque, low starting current, high efficiency and power factor and a fairly long air gap between stator and rotor cores to allow for wear in the bearings. It is generally recognized that it is inherently impossible to incorporate all these features in one induction motor. One or two of them may be obtained in the one machine but at a sacrifice of the others.

The shorter the air gap is made the higher will be the power factor of a given motor; however, a short air gap jeopardizes the reliability of the motor, since a small wear in the bearings will allow the rotor to rub on the stator and require frequent renewal on adjustment. High starting torque with low starting current and high power factor can be obtained by using a high-resistance winding on the rotor, but the efficiency will be low. If it is desirable to maintain the starting current at a fairly low value and retain high efficiency, then the power factor and torque will be reduced. Some of these difficulties can be overcome by the use of a wound-rotor motor, but then a less reliable and more expensive machine is obtained.

The foregoing are some of the conditions that the power companies must have in mind when putting restrictions on the starting current taken by induction motors connected to their systems. If these starting currents are limited to too small a value, the proper

size motor cannot start its load, with the result that larger machines will be installed. These being only partly loaded, will operate at a reduced power factor. If a higher starting current is permitted, its bad effects may occur for only a few seconds once or twice a day and the motor may operate at high power factor during its entire period of operation. On the other hand, if a larger motor must be installed in order to start the load on account of restricting the inrush per horsepower to a low value, favorable starting conditions may be obtained, but with low power factor and all the other evils of over-motoring during operation.

Where frequent starting and stopping are involved, as on elevators and cranes, high starting currents per horsepower should not be tolerated. The use of a high-torque motor will not only keep the starting current within comparatively low values, but the motor will also do its work with a smaller power consumption, even if its efficiency is low. These applications are among the easiest to take care of. With general industrial application, the satisfactory solution of the problem is by no means simple and requires the co-operation of manufacturers, power companies and users of the motors, if best results are to be derived for all concerned.

Know Your Costs

MANY an isolated plant has been displaced by central-station power for no better reason than that the engineer did not have at his finger tips the facts that would show the inadvisability of such a change. For this reason, if for no other, the operating engineer who values his own job and has an eye to the best interests of his employer must be actively concerned about costs.

A large corporation, such as that which operates the average central station, is able to employ sales engineers highly skilled in the art of figuring relative costs. It is their business to make out the best possible case for the use of purchased power. When they submit to the plant owner a report stating that a substantial saving can be made by the use of purchased power, the plant engineer is usually given the opportunity to analyze the report and submit his own comparative figures. At such times it is not enough for him to *believe* that he is making power more cheaply than it can be bought. He must have the *figures* and be able to demonstrate their correctness to the satisfaction of his employer. Moreover, he must be able to analyze the report of the power company and show just where it fails to give a true picture of the facts, if such be the case.

The majority of isolated plants exist because they render a certain service at lower cost than if power were purchased. Ordinarily this service involves not only power, but steam for heating or process work. In such cases it is particularly easy to overestimate the saving in fuel, labor, supervision, etc., that will result from the purchase of power.

Another matter worthy of careful consideration is the question of interest and depreciation. These are proper charges against the cost of generating power, but that does not mean that these charges would cease by the mere act of shutting down the plant. It must be remembered that the plant has already been paid for. Until it has worn out, it is not good business to shut it down unless the total cost of using purchased power (including interest and depreciation on any new investment this may require) is less than the bare operating cost of running the present plant. This is an important point and one that is often overlooked. Of course, when the plant has worn out, the question may again arise in a new form, because here the total cost of generating power—including interest and depreciation on the new investment—must be less than the total cost when buying power. At this point a knowledge of power-plant costs is again of the utmost value to the engineer, because it enables him to recommend the type of plant that will give the lowest total cost.

But a knowledge of costs does more for the engineer than merely help him to insure fair consideration of all the facts; it enables him to change the facts themselves by stopping all kinds of leaks and thereby decreasing the cost of the service furnished by his plant.

The Unaflow Engine

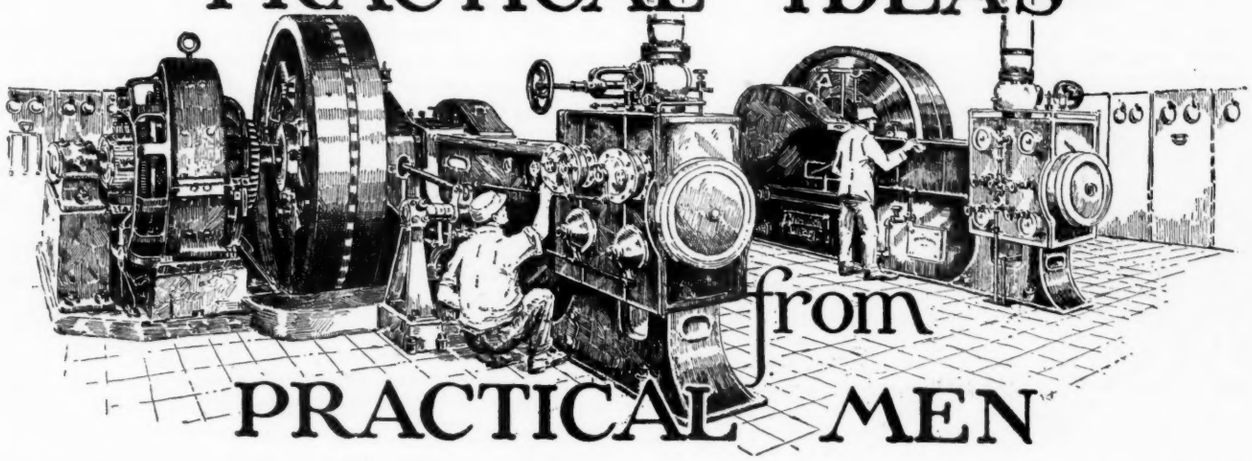
THOSE who are not in close touch with power statistics are prone to believe that the major part of the energy output of the country is produced in the large central stations. On the contrary, census reports show that the greater part of the total horsepower capacity is in industrial plants, the majority of which are small or of medium size. The efficiency of the large plants is about as high as can be secured with the present type of prime movers, whereas the small and medium-sized plants afford wide opportunities for reduced generating costs. The necessity of an efficient prime mover for these plants is at once apparent and the economies to be secured conceded.

The engineer whose work is confined to the management of a single plant, often finds it difficult to visualize the progress going on in the engineering world and consequently is often not acquainted with the improvements made in prime movers. With the idea of giving its readers a comprehensive view of the status of the unaflow engine, *Power* has gathered very complete data on the subject. This survey, which appears elsewhere in this issue, shows why the unaflow-engine installations have increased year by year and also classifies the total installed capacity by the industries served.

The reader will find that the average horsepower per unit is around two hundred and fifty, showing that this type of engine is adaptable to the medium and small plants. On the other hand, it is interesting to learn that a twenty-thousand horsepower unit is being built, showing that for certain classes of service the advantages of the engine over other types of power offsets the higher first costs.

"Seek money and you shall lose it, seek to serve and you shall have wealth added to that which you have," said Harry O. Garman, in his retiring address as president of the American Association of Engineers at its convention at Salt Lake City, June 5. He suggested that perhaps the Association had been overemphasizing the matter of compensation. The question of salaries has undoubtedly been stressed, and although that has perhaps been one of the foremost reasons for the phenomenal growth of the organization in the last few years, it has, in a way, set it apart from other engineering societies. It is commendable that Mr. Garman has suggested moderation in such activities and has pointed out that emphasis upon service is more profitable and satisfactory in the long run.

PRACTICAL IDEAS from PRACTICAL MEN



Prolonging the Life of Globe Valves

Whenever possible a globe valve should be wide open or tightly closed. When there is a small opening only, the steam or water forcing its way through wears the seat and disk unevenly. However, in many cases it is necessary to allow a small amount of steam or water to pass through a valve, and this soon cuts the seat or disk and the valve must be refaced.

After a valve has been refaced several times, it is seldom tight under high pressure. One reason for this is that a much larger seat area is formed by the repeated regrinding. This requires more pressure to be applied to the valve wheel to get a tight seating. It frequently happens that the greater force used in closing the valve and the increased seat area cause the disk-holder rim and the valve seat to come into contact. Under this condition a tight-valve is impossible. By placing a thin washer under the disk in the holder, this trouble is readily eliminated. JAMES E. NOBLE.

Toronto, Ont., Canada.

Plugging a Broken Ammonia Pipe

The following incident may be of help some time to the engineer of a refrigerating plant, in the event an ammonia pipe should break.

A number of years ago I was connected with a plate ice plant in the Middle West, and one day while harvesting ice one of the cakes broke in the slings while being hoisted out of the tank. Part of the cake fell on an expansion valve, breaking off the nipple that connected the valve to the 4-in. liquid header, close to the surface of the header.

Of course there was an immediate eruption of liquid ammonia, and also of the harvesting crew, who found pressing engagements elsewhere. To save the charge in the rest of the system, a valve in the 4-in. header, where it joined the main supply pipe, was closed at once, and a hasty consultation was held as to ways and means for saving as much as possible of the liquid in the header, which was about two hundred feet long.

Gas masks or helmets were unknown in those days, but one of the men volunteered to attempt to drive a plug in the opening if a stream of water was played on and about him while he was doing it. It was decided that a wooden plug would be of little use, but a steel center punch might do the trick. A section of fire hose was unwound from the reel and connected up, and the man, armed with the center punch and a husky hammer, with a coat wrapped around each arm and another around his head and neck, all of which were thoroughly drenched with water, started on his errand, with the stream from the hose following him. The hole was plugged and he returned with very little harm.

In the mean time the valves in the headers (there were four of them altogether) had been closed and the work of pumping out the damaged header started, and in a surprisingly short time a new valve and connection had replaced the broken one, and the plant was again in working order ALONZO G. COLLINS,

Philadelphia, Pa. Consulting Engineer.

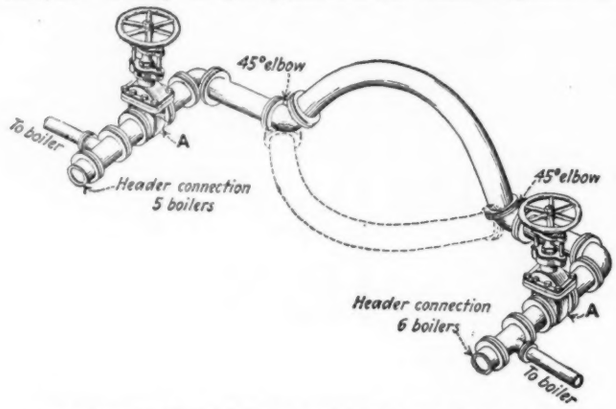
A Cause of Boiler Vibration

I was much interested in a recent discussion relative to the causes of boiler vibration, and after 40 years' experience with steam, I firmly believe that most of it is due to faulty pipe design and careless fitting. Given pipe of ample size, properly fitted and supported, well drained and expansion provided for, and 90 per cent of your boiler vibration is eliminated.

In many cases contractors and consulting engineers, in making changes in a plant, do not take sufficient time to study the existing conditions, but take measurements, make sketches, then order the work done and are surprised when their plans do not turn out as they expected. Some years ago a 2,500-hp. engine was added to a street-railway plant. As the plant was originally laid out the 12-in. steam mains from each battery of boilers came to a dead end at the valves *AA*, shown in the cut. It was desired to cross-connect the mains in order to get steam from any of the boilers to the new engine. Accordingly, a piece of pipe was bent to a 6-ft. radius and connected in the line in a vertical position, with two 45-deg. elbows. From the first time steam was turned on the line, there was bad vibration. One could look at the pipe and count the pulsations of the engine, and all four joints on the 45-deg. elbows leaked badly. The sheet packing was blamed for that, and gasket after gasket was replaced, until it became almost a continuous performance. During a period of four hours of the morning watch the load was light enough to run with five boilers, and that time was spent in replacing gaskets. Finally, the chief suggested turning the expansion bend on its side with the convex side

toward the boilers. This was done and all vibration and leaks ceased.

I once had occasion to remove the stop valve from the steam main of a vertical boiler. When the bolts were removed, the boiler sprang back to its original vertical position, leaving a gap of 2½ in. between flanges. Every flange joint should come together in



CHANGING BEND FROM VERTICAL TO HORIZONTAL POSITION ELIMINATED VIBRATION

perfect alignment so that it may be bolted up, without undue strain, yet frequently long bolts are used to bring the flanges near enough together to get the nuts on the regular bolts.

In pipe work some workmen are prone to be careless and will resort to "tricks of the trade" to cover up mistakes in measurements and poor fitting. When "making on" flanges, if pains are not taken to align the bolt holes, they will afterward be chipped and filed, thereby weakening the flange that amount. In places where joints are difficult to get at, many workmen will neglect to properly tighten the nuts on some of the bolts, and this usually results in leaky joints. Many steamfitters, when they are called in to make repairs, will rip the pipe covering off in pieces in place of removing it carefully so that it may be replaced. Workmen of this type would do well to bear in mind that a tight and neat pipe line is a joy to the operating engineer and the plant-owner. M. M. BROWN.

Camden, Me.

Engineers Should Welcome the Boiler Inspector

Some engineers are indifferent toward the boiler inspector. They consider inspections unnecessary, and for this reason give the inspector in many cases very little consideration or co-operation, without which the best results cannot be obtained. It is too frequently the case that when the inspector arrives he finds the boilers have not been properly prepared; in many cases the only preparation made is the draining of water from the boiler. This is not sufficient; the boiler should be taken out of service far enough in advance for the manhole plates to be removed and the boiler allowed to cool and dry thoroughly. It is also essential that the ashes be removed from the furnace and combustion chambers and the soot swept from the sheets, heads and tubes so that all external surfaces can be thoroughly examined. I have frequently been told by engineers that they have known leaks or other external defects to exist which the inspectors never found; but on tracing the matter out, it was found that conditions were such that the external inspection was made by looking through the furnace and clean-out openings, and had been so reported. It is possible, however, for defects or unusual conditions to exist that an inspector might not discover. If the engineer knows of such a case, no matter how trifling it may appear to him, he should call the inspector's attention to it, as, if not rectified, it might develop into a serious condition. It is to the mutual benefit of both the engineer and the inspector to discuss the general condition of the boiler plant.

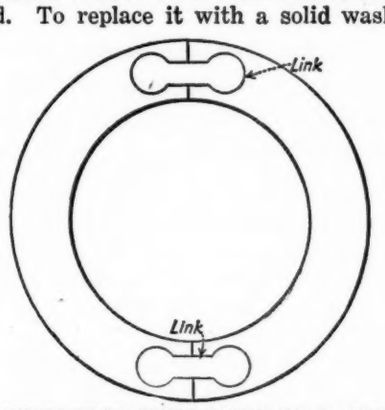
Some of the most serious defects I have found were hidden, but were brought to my attention by the engineers. Three of these were longitudinal lap-seam cracks that had shown leakage while the boilers were operating. The engineer, believing them to be ordinary leaks, had the brickwork removed and employed a boilermaker to calk the seams. In one case the seams had been calked a second time, but fortunately an inspection was made shortly afterward and the source of the trouble located. The boiler was 72 in. x 18 ft., horizontal-tubular, single-sheet type. The side tubes were removed in order to reach the seams. Upon examination cracks ranging in length from 8 to 42 in. were found on each side of the boiler along the edge of the lap. These cracks had started on the inside of the shell and had slowly developed.

I have observed in recent years that engineers are showing more interest in boiler inspection. This, in my opinion, is due to a higher class of men being in charge of the plants and to the engineer's license law, for it has been my experience that where an engineers' license law is in force, a more intelligent class of men may be found. J. LUTHER.

Charleston, W. Va.

Metal Thrust Washer Replaced With Fiber One

Some time ago, while I was employed in an industrial plant, the thrust washer on the main drive shaft had to be renewed. To replace it with a solid washer would



FIBER THRUST WASHER MADE IN HALVES AND FASTENED WITH LINKS

have entailed a great deal of work and expense, and to avoid this a fiber washer made in halves was adopted. It was first cut to the proper inside and outside diameters and the holes were drilled to form the ends of the link spacing. The washer was then cut in half and the links fitted.

This thrust washer has been in service for several months and is giving good results. W. A. FORD.

Helmetta, N. J.

COMMENTS FROM READERS

Sizes of Wire for Motor Circuits

Referring to the article, "How to Compute a Complete Motor Installation," by Edgar P. Slack, which appears in the May 2, 1922, issue of *Power*, in regard to Case 2, concerning the branch circuit for a 40-hp. three-phase squirrel-cage motor operated by an auto-starter, I note that this circuit is specified for 200 per cent of the motor's rated current, or 116 amperes, which requires a No. 0 wire and can be fused according to Table C of Code Wiring Table with 200-ampere fuses.

However, since the 200 per cent allowance is made to accommodate the large starting current, 200 per cent of the motor's rated current, or 116 amperes, can be considered as the normal starting current, and therefore 125-ampere fuses should be sufficient; and since the line can be fused to table C wire, a No. 2 wire appears satisfactory, especially if the fuses can carry a current 50 per cent greater than rating for a given period. Therefore, during the starting period 150 per cent of 125 amperes, or 187.5 amperes, can be used for a short interval, which is over 300 per cent of the motor's rated current, and this appears ample for any starting requirements when using an auto-starter.

By the use of No. 2 wire instead of No. 0 wire there is a saving in copper, and if the wire is in conduit, 1½-in. instead of 2-in. conduit can be used.

J. C. ALLEN, Engineer,
Wilmington, Del. Atlas Powder Company.

The criticism of Case 2 is found to be in order, and No. 2 B. & S. gage wire is proper for this case instead of No. 0 as originally stated. The error arises in interpreting Rule 8-c on pages 18 and 19 of the National Electrical Code. It appeared as if the second fine-print note on page 19 dealt with the capacity of the conductor and that the coarse-print paragraph preceding it showed how the conductor so chosen might be fused; and this interpretation has also been made by other engineers. The question has been referred to the National Fire Protection Association committee on the subject, who advise that the solution by Mr. Allen's method is correct. Consideration will be given in the next edition of the Code to clearing up the ambiguity that at present apparently exists.

For an induction motor rated 58 amperes, started by an auto-starter, 200 per cent of the rating is 116 amperes; and reference to Table C, Rule 18, shows the corresponding wire size to be No. 2 B. & S. gage in that portion of the circuit not protected by the motor cutout. This rubber-covered wire would be protected by 125-ampere fuses under Table C. This wiring and fusing should meet the ordinary commercial requirements.

EDGAR P. SLACK, Asst.,
New York City. Underwriters Laboratories.

[The error that Mr. Allen has called to attention is one made by a large percentage of those who use the Code. Fortunately, the error has been on the safe side in so far as the size of wire is concerned. The whole question is one that centers around selecting the size of wire to carry the increased current rating according to Table A or Table C. In the article a rubber-covered wire was chosen of a size to carry the 200 per cent current and then fused according to Table C, and this, although wrong, is the interpretation in general placed upon this section of the Code. On the other hand, the size of wire may be chosen according to Table C and the size of fuse based on this carrying capacity, but a rubber-covered wire used, which is the correct interpretation. However, if this interpretation were applied to this rule in editions of the Code earlier than 1918, where the percentage of full-load current for alternating-current motors above 100 amperes is taken at 150, it would fail to meet the requirements for normal motor-current capacities, since the carrying capacities in Table C are about 50 per cent greater than the allowable capacities in Table A. Therefore the size of wire would have a carrying capacity equal to about normal current of the motor, which would not meet the requirements of the Code for a rubber-covered wire used on motors. In this case for the rule to be workable, a rubber-covered wire had to be selected according to Table A and then fused according to Table C, or what was in the earlier editions of the Code Table B. It is to be hoped that the new edition of the Code will have the point raised by Mr. Allen cleared up, so that there will be no question as to what is the correct interpretation.—Editor.]

Evaporators for Small Boiler Plants

In the May 16 issue J. W. McCausland, commenting on my letter in the April 11 issue, says that a "properly correlated" evaporator system using feed water in its condenser does not reduce plant efficiency by taking away the opportunity to heat feed water by means of steam bled from a turbine. He also asks, "in the first place where is there a small steam plant equipped to bleed steam from mid-stage of the main turbines?"

Mr. McCausland can study such an installation in the description of the "110,000,000-Gallon Pump for St. Louis," described in *Power*, Dec. 4, 1917, page 753.

It is not only possible, but practicable, to bleed pressure-stage turbines from any stage, and it is prophesied by one of the large turbine manufacturers that in the future turbines will be designed to be bled for feed heating at one or more stages, and that possibly the heaters will be incorporated in the turbine casing itself.

In an evaporator heat is let down in temperature without doing mechanical work. The heat may be recovered in heating feed water, but a valuable opportunity is lost; namely, the opportunity to turn heat into mechanical work without wasting any heat in the exhaust. This holds true regardless of whether the temperature range used by the evaporator is above or below 212 deg. F. It therefore applies to the so-called high-level evaporator systems which Mr. McCausland appears to have in mind.

A high-level makeup evaporator also interferes with the efficient use of flue-gas economizers.

As for multiple-effect evaporators it should be borne in mind that in proportion as the amount of water obtainable by letting a given amount of heat down through a given temperature drop is multiplied by the use of multiple effects, so also is the amount of heat-transmitting surface increased, and hence the cost of the evaporator is increased. In fact, the cost rises more rapidly than does the amount of distillate obtained. For example, if the temperature drop be divided into two parts by the use of a double effect, the amount of distillate obtained from a given amount of heat let down is not quite doubled. However, since the temperature difference acting upon each heating surface is only half of what it was in the single-effect evaporator, the amount of surface required in each effect will be twice what it was in the single-effect evaporator and the total amount of surface will be four times as great for less than twice the output. For the same output the total amount of surface would be practically doubled. Charges on equipment must, of course, be considered, as well as thermal efficiency.

New York City. G. H. GIBSON.

Blowing Off Not Dependable for Keeping Boiler Clean

In the April 25 issue M. W. asked the cause of a bag in the bottom of the shell of a horizontal return-tubular boiler. While I agree with the answer given, that it might have been caused by not cleaning the boiler often enough and that there can be no rule laid down for the length of time that should intervene between cleanings, I am of the opinion that oil was the cause of the trouble. He does not tell us whether the boiler was brand new or an old one newly installed, but in either case it should have been thoroughly cleaned before being put in service. Oil or grease is hard to remove from a boiler, and the most effective method in my opinion is to boil it out with soda. The soda should be dissolved before putting in the boiler, the boiler should then be left open and a slow fire kept under it for two or three days. Then this water should be drawn off and the boiler thoroughly washed out, preferably with hot water while the boiler is still warm. If there are other units in service, this can be done by attaching a hose to the feed pipe. Finally the boiler should be filled to the normal level and heated slowly before raising to the normal working pressure.

Norwich, Conn. W. D. THORP.

Form of Telescopic Valve

In reference to the description of a telescope valve in the May 30 issue, I have operated an engine fitted with one of these valves for twenty-one years, and the valve is still tight. The engine is connected to a 100-kw. generator and operates at 264 r.p.m. on 120 to 160 lb. steam pressure (not superheated).

The success of this valve depends on good lubrication and keeping the telescope element and packing rings in free working condition. E. G. HOPPE.

Cairo, Ill.

Steam- and Electric-Driven Refrigerating Plants

I read with interest, in the May 30 issue, the article by G. E. Porce regarding steam and electric-driven refrigerating plants. His tabulation showing a saving of from 19 to 26 cents per ton of ice by the use of the unaflow engine instead of purchased current is particularly interesting in view of the comparison being made with current at the low rate of 1¼c. per kilowatt-hour.

There are, I believe, few places in the country today where current can be secured at such a low rate. I have made an inspection within the last few months of fifteen plants using purchased current where the lowest rate was 1.63, the highest 4 and the average rate 2.7 cents. These plants were widely scattered, being in New York, Pennsylvania, Virginia and Missouri and consisted of a forging plant, a hotel, three wood working plants, three tanneries, a wool scouring and dyeing establishment, one woolen mill, one silk mill, two foundries and machine shops, two office buildings. Several of these plants operated on a 24-hour basis.

While Mr. Porce's article does not reveal the apportionment of charges, it is evident that if current costs more than twice as much as the rate assumed by him, the saving by operating unaflow engines as compared with purchased current will be much larger than as stated.

His assumption of $6 as the cost of coal in the unaflow-engine operated plant is not unreasonable. In my own observation in the fifteen plants mentioned, coal in the bin ranged from $3.35 up to $8.50, the average being $6.74.

It is interesting also to observe that in all the fifteen plants mentioned the installation of steam-driven units would be completely paid for by saving as against purchased current in from two to three years. Engines will be placed in many of these plants and a unaflow is already in operation in that plant which purchased current at the lowest figure of 1.63 cents and which pays the highest price for coal ($8.50) with an annual saving in operating expense of $4,800.

I do not wish to be interpreted as decrying the advantages in many locations of using purchased current, but I do wish to emphasize the remarkable savings that can be effected in large numbers and varieties of plants by the making of current with unaflow engines, whose wonderful steam economy has revolutionized power-plant practice and which have made possible the production of power in the majority of manufacturing plants at a cost that is much less than that resulting from the prevailing public-utility current rates.

Erie, Pa. R. C. STEVENS,
Consulting Engineer.

Flow of Air through Orifices

In the May 2 issue there appeared an inquiry as to the size of an orifice necessary to discharge 1,500 cu.ft. of air per minute from a gage pressure of 40 lb. per sq.in. and at a temperature of 140 deg. F.

In the reply to this question use was made of Fleigner's formula, which should not be used in the case of a square-cornered orifice. Referring to the report of experiments upon which this formula is based, appearing in *Der Civil-engenieur*, Vol. 20, page 14, it will be found that the experiments were conducted on two rounded orifices, one 4.085 mm. in diameter and the other 7.314 mm. in diameter. In the absence of any other equation it is very common to incorrectly apply Fleigner's equation to the square-cornered orifices, as has been done in this case.

In view of the need for a formula that could be correctly used, the author conducted an extensive series of experiments several years ago. An equation was derived from the results of these experiments, which is as follows:

$$Q = \frac{405A\ (P_1^2 - P_2^2)^{0.48}}{\sqrt{T}}$$

in which

Q = Cubic feet of air at 32 deg. F. and 14.7 lb. discharged per minute;

A = Area of orifice, sq.in.;

P_1 = Initial pressure before orifice, lb. per sq.in. absolute;

P_2 = Final pressure after orifice, lb. per sq.in. absolute;

T = Absolute temperature of air entering orifice, deg. F.

This equation has been used by other investigators and has been found to give quite satisfactory results.

In order to avoid the more or less awkward computations involved in the use of the fractional exponent that appears in this formula, the author has compiled a graphic chart from which the air flow can be quickly determined.

Applying this formula and chart to the problem given, it is found that the volume of air discharged per minute per square inch of orifice from a gage pressure of 40 lb. per sq.in. and a temperature of 140 deg. F. amounts to 745 cu.ft. of free air per minute.

The exact procedure followed in obtaining this figure may be briefly described as follows:

Entering the chart at the lower left-hand corner at a pressure of 54.7 lb. per sq.in. absolute (40 lb. gage) and passing vertically up until the discharge-pressure line of 14.7 lb. per sq.in. absolute is reached, then horizontally to the right to the temperature curves which are interpolated to the temperature of 140 deg. and then vertically down, obtaining from the scale on the lower right-hand side of the sheet a flow of 745 cu.ft. of air per minute. This operation is illustrated by the dotted lines.

Since it is desired to discharge 1,500 cu.ft. of air per min., the required area would be $\frac{1,500}{745} = 2.015$ sq.in., while the diameter would be $\sqrt{2.015 \div 0.7854} = 1.60$ in. instead of 1.43 in.

It will be seen that the area of the orifice as given by Fleigner's formula is about 20 per cent too small.

The complete data upon which this formula is based will be found in the "Transactions of the American Society of Mechanical Engineers," Vol. 38, page 799.

New York City. HERBERT B. REYNOLDS.

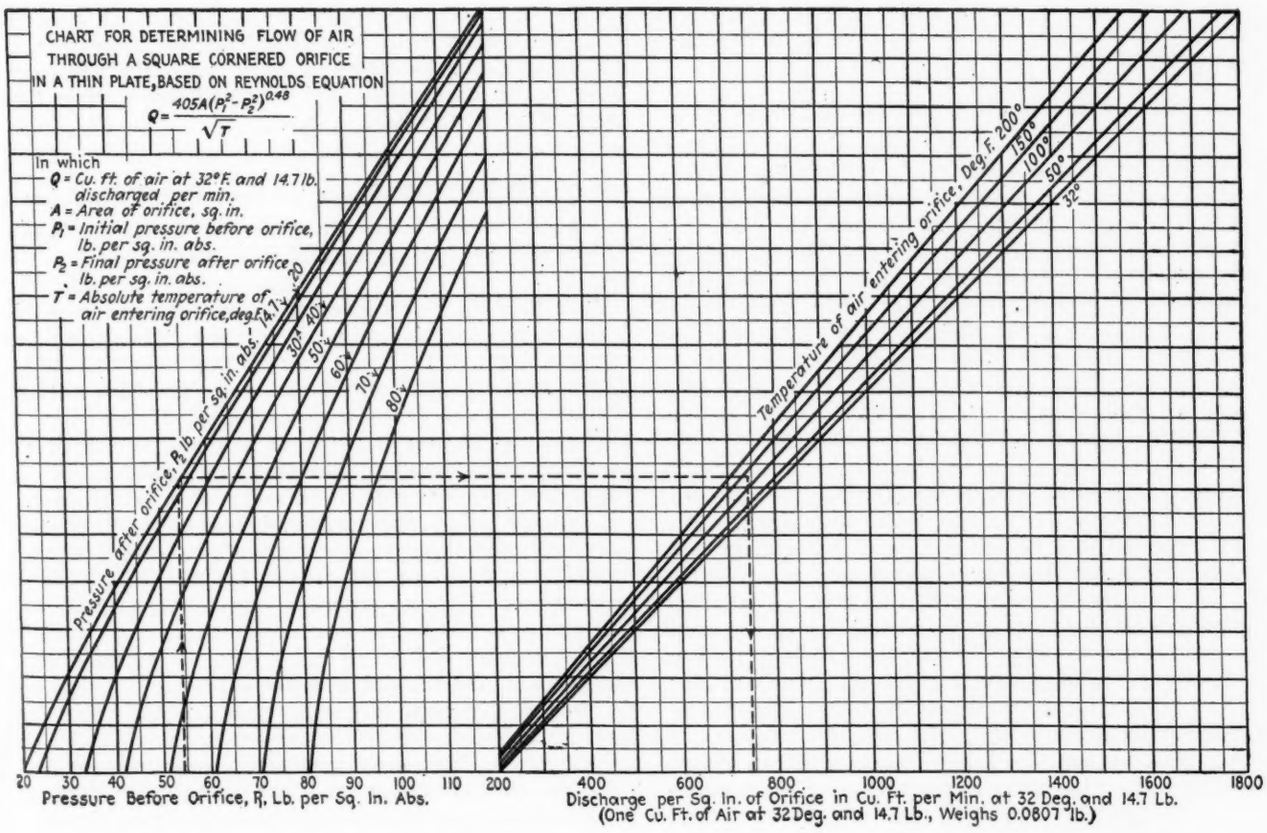


CHART FOR DETERMINING FLOW OF AIR THROUGH A SQUARE CORNERED ORIFICE IN A THIN PLATE, BASED ON REYNOLDS EQUATION
$Q = \frac{405A(P_1^2 - P_2^2)^{0.48}}{\sqrt{T}}$
In which
Q = Cu. ft. of air at 32° F. and 14.7 lb. discharged per min.
A = Area of orifice, sq. in.
P1 = Initial pressure before orifice, lb. per sq. in. abs.
P2 = Final pressure after orifice, lb. per sq. in. abs.
T = Absolute temperature of air entering orifice, deg. F. + 461
Pressure after orifice, P2, lb. per sq. in. abs.
20
30
40
50
60
70
80
Temperature of air entering orifice, Deg. F.
200°
150°
100°
50°
32°
20 30 40 50 60 70 80 90 100 110 200
Pressure Before Orifice, P1, Lb. per Sq. In. Abs.
400 600 800 1000 1200 1400 1600 1800
Discharge per Sq. In. of Orifice in Cu. Ft. per Min. at 32 Deg. and 14.7 Lb.
(One Cu. Ft. of Air at 32 Deg. and 14.7 Lb., Weighs 0.0807 Lb.)

GRAPHIC CHART FROM WHICH THE QUANTITY OF AIR DISCHARGED CAN BE QUICKLY DETERMINED

QUESTIONS AND ANSWERS

Detection of Ammonia Leaks

How can ammonia leaks in a refrigerating system be detected? R. G.

To test for leaks of joints to the atmosphere, light a sulphur stick or ordinary sulphur candle and hold it near the suspected point of the leakage—under it if possible. The fumes of burning sulphur are nearly invisible, but if they mingle with ammonia gas, a dense grayish-white vapor is formed. Leaks into water or brine can be detected by dipping red litmus paper into the liquid. Any large proportion of ammonia present will turn the color of the paper to a deep blue, while small traces will barely change the color. For detecting ammonia in calcium brine, use Nessler's solution, which is also a good test for salt brine and water tests. The formula for the preparation of Nessler's solution is given on page 117, Jan. 18, 1921, issue of *Power*. In calcium brine this solution forms a precipitate; but if no ammonia is present, the precipitate will be white. In water or salt brine the precipitate will be yellow if there is but a trace of ammonia present and reddish-brown if there should happen to be much ammonia in the sample.

Size of Smoke Flue and Draft Losses

What should be the size of smoke flue for a battery of boilers containing 5,000 sq.ft. of heating surface, and what allowances should be made for loss of draft due to the length and angles in the flue? W. L. G.

A safe rule for figuring cross-sectional areas of circular iron flues is to allow 3.5 sq.ft. per 1,000 sq.ft. of boiler-heating surface, so that 5,000 sq.ft. should have a cross-section flue area of about 17.5 sq.ft., or about 56½ in. diameter. The area at any point may be in proportion to the volume of gas that will pass that point, and when two or more branches discharge into the same duct, each junction should be provided with a baffle for turning the gases into the main flue without interfering with the passage of gases from connections that are more remote from the stack. The retarding effect of a square flue is 12 per cent greater than that of a circular flue of the same area, and that of a rectangular flue with sides as 1 to 1½ is about 15 per cent greater than for a circular flue of the same cross-sectional area. For iron flues there is draft loss of about 0.1 in. of water per 100 ft. length of flue and 0.05 in. loss for each right-angle turn. The retarding effect of brick or brick-lined flues is about one-third more. When a turn is made by an easy-bend elbow, having a center line curved to a radius of three diameters or more, the draft loss is practically no more than for the same length of straight flue.

Increasing Speed of Corliss Engine

If a Corliss engine is running at 100 r.p.m. and it is desired to change the speed to 115 r.p.m., is there any other way than to change the pulley or increase the weighting of the governor? M. M.

When a governor weighting is increased, regulation takes place at higher speed because the governor is not permitted to rise high enough to effect reduction of the fraction of cutoff until the speed is sufficient to produce enough centrifugal force to overcome the weighting of the governor. A reduction in size of the governor flyballs without changing the weighting would result the same as increasing the weighting without changing the governor flyballs, because higher speed of the lighter balls would be required to produce sufficient centrifugal force to lift the weighting and bring the governor to a position that will check the speed of the engine by effecting shorter cutoff. Still another method of obtaining regulation at higher speed would be to lengthen the vertical connection from the governor collar to the bell crank for operation of the reach rods to the cutoff, or varying the length of the rods so the valves will give the average cutoff when the governor balls are at the height that they will have when the engine runs at the desired speed.

Single-Valve High-Speed vs. Low-Speed Engines

What are the relative advantages and disadvantages of single-valve high-speed and low-speed engines? W. B.

As a class high-speed engines have the advantage of being more compact for a given power, are simple in construction and relatively low in first cost and have closer regulation of speed and are therefore better adapted to driving electric generators.

The disadvantages of single-valve high-speed as compared with low-speed engines are rapid alternation of admission and compression of steam through ports to the cylinder areas, and the rapid motion of piston requires generous piston clearance of each end of the cylinder between the piston and cylinder heads with greater loss of steam economy from clearance. With high-speed engines the heating and wear are more rapid, resulting in possible increase in expense for maintenance and repairs, greater expense for lubrication and requirement of greater care in adjustment of bearings and decrease in economy with use from leakage of valves. These disadvantages are overcome only by a standard of design and workmanship in fitting, and provision for wear which makes high-speed engines costly to build and successful only when well made.

Heat Balance in Boiler Operation

What is meant by the heat balance of a boiler, and what is the purpose of such a computation?

W. L. C.

The heat balance of a boiler is a tabulated statement, or balance sheet, in which the useful output and losses of heat are balanced against the heat that would result from theoretically perfect combustion of the fuel used.

The purpose of such a balance sheet is to obtain an exhibit of the operating results and conditions for studying the possibility of a reduction of heat losses and for comparison with results obtained in the operation of other boilers. The statements usually are reduced to the number of B.t.u. with which each item of output or loss is chargeable per pound of fuel used and their respective percentages.

The data required for computing the items usually included in a heat balance are: Temperature of boiler room; temperature of escaping gases; ultimate analysis of the fuel; B.t.u. per pound of dry fuel or fuel free of moisture; B.t.u. per pound of combustible; percentage of ash found by test; percentage of combustible in the ashes; flue-gas analysis; and evaporation of the boiler from and at 212 deg. F. per pound of fuel.

The usual items of a boiler heat balance are those quoted in the following example, in which the heat value per pound of dry fuel is 14,460 B.t.u.:

	B.t.u.	Per Cent
Heat absorbed by boiler in generation of steam	9,917	68.58
Loss due to moisture in coal	51	0.35
Loss due to moisture formed in burning H in coal	472	3.26
Loss due to heat carried away in dry chimney gases	2,367	16.37
Loss due to incomplete combustion of carbon	257	1.78
Loss due to unconsumed carbon in the ash	687	4.75
Loss due to radiation and unaccounted losses (balance)	709	4.91
B.t.u. per pound of fuel	14,460	100.00

Greater Initial Pressure for Running Non-Condensing

Having a Corliss engine supplied with steam at 120 lb. boiler pressure, cutting off at ¼ stroke and running condensing with 26 in. vacuum, what would the initial pressure have to be to develop the same power running non-condensing with the same point of cutoff?

A. F.

Referring to a table of "Mean Pressure per Pound of Initial, with Different Clearances and Points of Cutoff," such as given on page 115 of F. R. Low's "Steam Engine Indicator," and assuming 5 per cent clearance, it may be seen that the average pressure per pound of initial absolute for ¼ cutoff would be 0.6258 lb. Hence, for an initial pressure of 120 gage, or 135 lb. absolute, the average forward pressure would be $0.6258 \times 135 = 84.48$ lb. per sq.in. absolute. The back pressure due to 26 in. vacuum would be $(30 - 26) \times 0.491 = 1.964$ lb. per sq.in. absolute. Allowing 2 lb. additional average back pressure from compression of the exhaust, the total average back pressure would be about 4 lb. and the m.e.p. $= 84.48 - 4 = 80.48$ lb.

To develop the same power, the m.e.p. would have to be the same whether running condensing or non-condensing. Allowing, when running non-condensing, that the average back pressure above atmospheric pressure is 3 lb. and the average absolute back pressure is $3 + 14.7 = 17.7$ lb., a mean effective pressure of 80.48 lb. would require the average forward pressure to be $80.48 + 17.7 = 98.18$ lb. per sq.in. absolute, and therefore the initial pressure when running non-condensing would need to be, $98.18 \div 0.6258 = 156.8$ lb. per sq.in. absolute, or $156.8 - 14.7 = 142.1$ lb. boiler pressure.

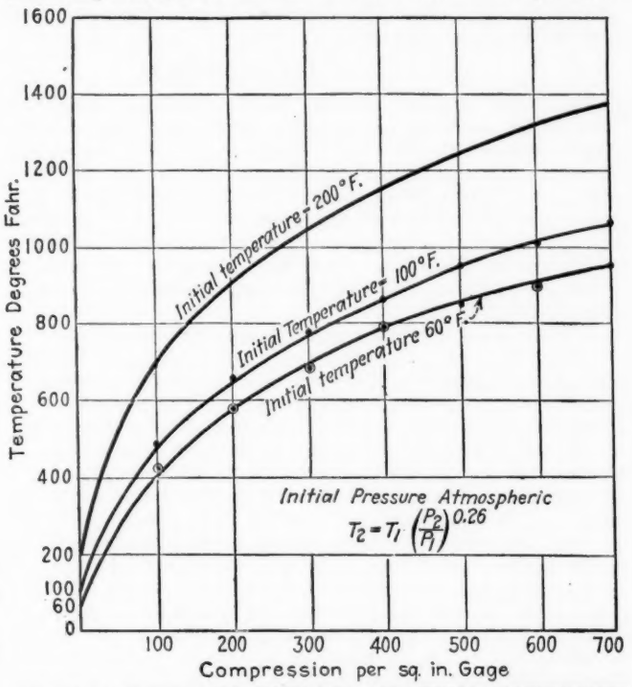
Why a Diesel Engine Smokes Upon Starting

Why does a Diesel engine when first starting show much smoke at the exhaust, while after warming up the dark color disappears and the engine runs satisfactorily?

R. C. L.

The fuel oil introduced into the Diesel cylinder is ignited by the temperature of the charge of air that has been raised to a high value by being compressed by the piston. If the temperature is not considerably above the igniting temperature of the oil, only the light portions of the oil will burn, while part passes out of the cylinder in an unburnt condition.

The temperature that the air attains at the end of the compression stroke, depends upon the ratio of clearance volume to total cylinder volume and upon the temperature of the air as it enters the cylinder.



TEMPERATURES ATTAINED BY AIR WHEN COMPRESSED FROM ATMOSPHERIC PRESSURE AT 60, 100 AND 200 DEG. F.

Since the pressure depends upon the volume ratio, the relation of the air temperature may be expressed by the equation

$$T_2 = T_1 \left(\frac{P_2}{P_1}\right)^{0.26}$$

If T_1, the temperature of the incoming air, is low, then T_2 will also be small. Upon starting, T_1 is about 60 deg. F., but as the engine warms up the air entering the cylinder is heated by the air passage until it may be as high as 200 deg. F. In the chart are shown the temperatures that will be reached by different compression pressures. With the initial temperature at 60 deg. F. it will be noted that 500 lb. compression will give a final temperature of 850 deg. F., which is below the igniting temperature of all but the light oils. The curves show the necessity of high compressions to insure ignition.

In addition, upon starting the cylinder walls are cold and if any of the fuel strikes the walls it will deposit soot, which blows out of the exhaust, giving a dark color.

[Correspondents sending us inquiries should sign their communications with full names and post office addresses.]

Views of House Committee on Muscle Shoals

Great pressure is being brought on the steering committee and on the majority leaders of the House of Representatives in the effort to bring about prompt consideration of the McKenzie bill, which would make it mandatory upon the Secretary of War to sell and lease to Henry Ford the various Muscle Shoals properties and rights of the Government. The McKenzie bill excludes from any offer the Government's equity in the steam plant on the Warrior River at Gorgas. Arrangements are being made to circulate a petition among members of the House asking for consideration of the bill. If the signatures of a majority of the members of the House can be obtained, it would make it very embarrassing for the leaders to refuse to allow consideration of the bill. In view of the fact that the House now is marking time, awaiting Senate action on the tariff bill and other measures, the chances favor success in bringing about consideration of the measure.

Gorgas Plant May Be Included

The eight members of the Military Affairs Committee who signed the principal minority report have reserved the right to amend the McKenzie bill so that it will include the Government's interest in the Gorgas steam plant. While a bill introduced by Representative Wright, of Georgia, embodies the exact views of the minority, the fight will be on th McKenzie bill, introduced at the instance of the majority, which can be amended, if sufficient strength can be mustered, so as to express the views of the minority of the committee.

It is apparent from the report made by the majority of the committee that those members believe Mr. Ford would take over the properties if they were offered to him definitely, even were the Gorgas plant eliminated. The minority contends that the elimination of the Gorgas plant is equivalent to a rejection of the Ford offer. The minority questions the sincerity of the Alabama Power Co. in offering $2,500,000 for the Gorgas plant, but even if that amount could be obtained for it, it should not be allowed, these members say, to stand between the public and the great advantages that would accrue to it through acceptance of the Ford offer.

"The money consideration," the majority states, in commenting on the offer of Mr. Ford, "is not the vital one. If that were all, the committee would not have spent two hours in the consideration of the matter. It is the continuing considerations to be performed by Mr. Ford and his company over a long period of 100 years, which give to his proposal its merit."

Ford's Offer Best One Submitted

In first place among these continuing considerations, the majority places the obligation to provide nitrogen preparedness for 100 years, "a thing of far more importance," says the majority, "than the payment of a few millions of dollars." In second place the majority places Mr. Ford's obligation to run Plant No. 2 at full capacity in the production of the elements of commercial fertilizer. This, it is pointed out, likely is a greater undertaking than the maintenance of the plant as an element of national defense.

In addition to these two proposals, there are also the advantages that come from the payment of 4 per cent annually on the cost of completing Dam No. 2 and the construction of Dam No. 3, and on the cost of the flowage rights for the leased period. There is also the establishment of a sinking fund that will amortize the Government for the entire expenditure for the completion of Dam. No. 2 and the construction of Dam No. 3. These advantages, in connection with the other comparatively minor obligations, give Mr. Ford's proposal "commanding attention and one to which the Congress of the United States well may give its early and most earnest attention," says the majority. "Action by Congress is imperative," it continues, "and immediate action means economy if such action wisely provides for such disposition as will insure an income to the Government and not a continuous outlay. Two courses are open. One is Government ownership and operation, which in view of the character of the project would mean not only failure from the standpoint of income, but disaster to the hopes of the farmers and other users of commercial fertilizer. To have the Government undertake to engage in the manufacture of fertilizer ingredients, with political superintendence, foremen and straw-bosses, is unthinkable. To undertake such a scheme would be unspeakable folly. The alternate course is to sell the tangible property to private individuals, or to a corporation on conditions prescribed by Congress, lease the power at a fair rental, and permit individual American initiative and ingenuity to have an opportunity at this place, where the greatest waterpower in our country can be developed, requiring the preservation of the element of national defense and at the same time giving an opportunity for relief, if such there can be, not only to the Southland, but to our entire country in the way of commercial fertilizer at reasonable prices. Does the Ford proposal promise such a consummation? We feel that it does, or at least it is the only proposal yet made by anyone that even gives ground for hope. His offer is not entirely free from objections; however, it is of such great potential possibilities that the committee feels assured action by Congress will be prompt and a final and satisfactory adjustment can be reached."

The principal argument for the inclusion of the Gorgas plant is that it is essential to the economical operation of the nitrate plant. It is conceded that the exclusion of that plant will delay operations, but the majority feels that the objections outweigh the advantages. The fact that the plant is 88 miles distant and on a different stream leads the majority to the conclusion that it is a separate and distinct project, and "only by a stretch of the imagination can it be said to form a part of the proposed plant at Muscle Shoals." While the majority admits that the Government is under no obligation to the Alabama Power Co., it contends that it is far from fair to force upon the Alabama Power Co. a partnership that might be wholly unsatisfactory, and to dispose of the Government's right, without giving the owner of the real estate an opportunity to bid.

Minority Includes Gorgas Plant

While the minority, too, places greatest emphasis on nitrogen preparedness, those members of the committee go into detail to point out the importance of the manufacture and sale to farmers, and other users of fertilizers, of the equivalent of 2,000,000 tons of commercial fertilizer. The minority confidently expects "that the commercial fertilizer industry would be revolutionized and that farmers would be supplied with fertilizer in a concentrated form without the 1,700 pounds of inert matter added to each ton of commercial fertilizer as now manufactured. No less an authority than Thomas A. Edison has made the statement that fertilizers could be manufactured at Muscle Shoals at approximately one-half the present cost."

The minority emphasizes its belief that it would be unwise to jeopardize the Ford proposal and lose its manifold advantages by excluding the Gorgas plant. "We are unalterably in favor of the Government's standing by its contracts," says the minority, "but it would seem that the contract in question has neither the elements of law or morality and, therefore, has no standing." The minority points out that the Graham investigating committee denounced the contract between the Government and the Alabama Power Co. for the Gorgas plant in scathing terms. Attention is called to the fact that the Judge Advocate General of the Army pronounces the option to purchase as being void. It is pointed out by the minority that the Attorney General, in addition to pronouncing the option null and void, was not sparing in his denunciation of the "very hard and unequal terms sought to be imposed on the Government by the contract. A large number of the members of the Military Affairs Committee were almost shocked at the advantages sought to be taken of the Government by the terms of the contract."

Representative Parker, of New Jersey, and Representative Frothingham, of Massachusetts, also submitted minority views. They object to the plan of disposing of over $100,000,000 worth of property to Henry Ford and his company,

along with "the control of the greatest source of power in the East, without proper restrictions as to the distribution of that power to the public and with inadequate return to the Government." Messrs. Parker and Frothingham further object to the Government's assuming responsibility for the maintenance of the dam for 100 years, and declare that the whole proposition "is a departure from the policy of our water-power legislation." They contend that the dams should be leased under the water-power act, which provides for a fifty-year term and makes provisions for the use of the power for the benefit of the community.

"The primary power could be sold off the switchboard," say Representatives Parker and Frothingham, "at five mills a kilowatt-hour, which is equivalent to $31.25 a horsepower, so that $3,125,000 a year can be collected from the sale of the primary power alone, which is enough to take care of the interest and expenses and pay a large profit." They point out that an offer has been made by the Alabama Power Co. to complete the dam at its own expense and give the United States the first 100,000 secondary horsepower, if the Government will convey to it the steam plant at Nitrate Plant No. 2. It is pointed out that this steam plant, which generates 80,000 hp., is now rented and pays more than the cost of keeping that plant in stand-by condition. The nitrate plants are intended primarily for the manufacture of munitions of war and should not be conveyed to anyone, they say.

As to the Gorgas plant, Messrs. Parker and Frothingham contend that even if the Attorney General is right in declaring the option paragraph as void, the United States has no alternative other than to scrap the property. They agree that the fertilizer proposal is an advantageous one, but state that it is the bargain counter of the whole proposal, but really constitutes a very small part of it, and should not be allowed to prevent the Government from obtaining an adequate return for its properties and the proper security from the Ford interests. If Mr. Ford will not consent to modifications in his offer, they recommend that the Secretary of War be authorized to lease the dams and nitrate plants, including the quarry, separately or together, on such terms as will secure the completion of the dams, the preservation of the nitrate plants, and their availability to the Government in case of emergency. They think also the Secretary should be authorized to settle the fair value of the Gorgas plant and convey it to the Alabama Power Company.

Another Oil Field Boiler Explosion

By C. W. Carter, Jr.

Explosion of another boiler of the type extensively used in the oil fields took place on the Hosmer farm at Olean, N. Y., at 10 a.m. on June 3.

This boiler was of the locomotive type of 300 sq.ft. heating surface; the original shell plate was $\frac{5}{16}$ in. thick and the plate in the firebox $\frac{1}{4}$ in. thick. The firebox and wrapper sheets were badly pitted and grooved, and in some places were reduced in thickness to $\frac{1}{16}$ in. The firebox staybolts were originally $\frac{3}{4}$ in. in diameter and were pitched $4\frac{7}{8}$ in., 5 in. apart. The boiler was fitted with a ball-and-lever safety valve, but this could not be found after the explosion. The pressure carried at the time of explosion was 80 lb., but there seemed to be considerable doubt as to the accuracy of the gage.

FIG. 1. CYLINDRICAL SHELL TORN FROM TUBE SHEET

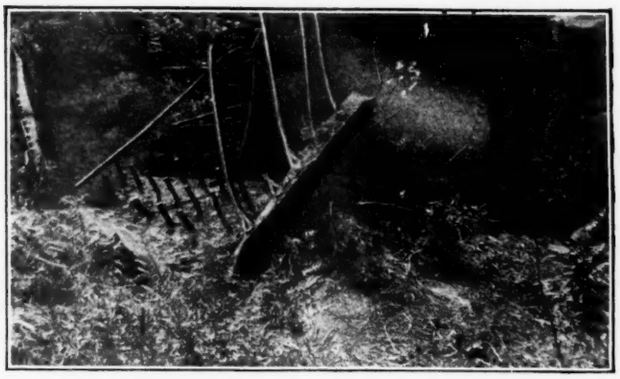


FIG. 2. DOME AND WRAPPER SHEET TORN FROM FIREBOX SECTION

The throat sheet of the boiler fractured at the barrel and mud ring seams, completely separating the cylindrical shell from the firebox section, as seen in Fig. 1. The cone and upper section of the wrapper sheet were torn from the firebox, each piece being blown a considerable distance from the original location of the boiler.

A careful examination was made for defects which undoubtedly existed previous to the explosion, and the following was found: The sheets were badly corroded and pitted throughout the boiler, with several cracks radiating from staybolt holes, a total of ten broken stays, and several partly fractured.

From information obtainable it appears that the boiler had never been inspected and had received very little attention. About one year previous to the explosion a boilermaker had repaired the boiler with a patch which extended the length of the firebox and took in two rows of staybolts. He also found that attempts had been made to stop the leaks then in evidence temporarily. This boilermaker informed the owner that the boiler was unsafe, but apparently no attention was paid to it.

No records of inspection for this boiler were obtainable, and it is to be regretted that such hazards are allowed to exist for want of a state law making the regular and thorough inspection of this class of boiler compulsory.

New York State N. A. S. E. Convention

The New York State Association of the National Association of Stationary Engineers held its twenty-seventh annual convention June 8-10, at the McAlpin Hotel, New York City. There were over one hundred delegates present. The sessions were held in the Colonial Room on the second mezzanine floor of the hotel. The spacious grill room was conveniently arranged with neatly decorated tables for the use of the eighty-five exhibitors in the display of their engine-room supplies and equipment. It proved of mutual importance to the engineer and supplymen that they met under the same roof, as was evidenced by the large attendance at the exhibit and the close and constant interest taken in the displays.

The opening of the mechanical exhibition took place on Thursday evening. T. J. Condin, director of exhibits, presided. Dr. Royal S. Copeland, New York Health Commissioner, gave an interesting address, which was heartily responded to by National Vice-President Frederick Felderman. The exhibit was then officially declared opened by James D. Taylor.

On Friday morning, the preliminary exercises of the convention were held. After an invocation by Staff Captain John Allen, of the Salvation Army, Chairman T. J. Condon introduced Farnham Yardley, president of Jenkins Bros. Valve Co. and representing the Merchants' Association of

New York, who addressed the company. He told of his appreciation of the preamble of the association and urged the members to continue to abide by it. He pleased the company by showing a picture of the delegates and guests attending an N. A. S. E. convention in New York City thirty-three years ago. National Vice-President Frederick Felderman, State President Samuel Thackaberry, Past National President John J. Callahan and National Trustee William J. Reynolds also made addresses that were warmly received. The delegates then went into executive session and after the necessary committees were appointed an adjournment was taken until the afternoon session.

On Thursday afternoon a visit was made to the plant of the New York Waterside Station.

The entertainment feature was the banquet, entertainment and dance in the main dining room on Saturday evening.

The following state officers were elected: W. B. Smith, president, Niagara Falls; A. S. Bennett, vice president, Brooklyn; W. W. Minzer, secretary, Brooklyn; William Downes, treasurer, Manhattan; E. J. Young, conductor, Niagara Falls; William J. Ranton, doorkeeper, Rochester; John McInnis, chaplain, Manhattan. Robert Sterling, of Rochester, was recommended for state deputy.

The employees of the McAlpin Hotel eagerly co-operated to make the conventionites comfortable.

The convention committee included T. J. Condin, A. S. Bennett, P. J. Cassidy, John P. Martin, S. I. Schaff and William Logan.

The next annual meeting will be held at Niagara Falls in June, 1923.

Illinois State N.A.S.E. Meets in Chicago

On the Municipal Pier, Chicago, from June 7 to 10 inclusive, the Illinois State Association of the National Association of Stationary Engineers held its eighteenth annual convention. This was the second consecutive year that the pier has been utilized for this purpose. With abundant space, cool lake breezes making for comfort and convenient transportation facilities, the location was an ideal spot for the mechanical exhibit. With 190 booths, the gratifying record of last year was almost equaled and in other ways excelled. The booth space was larger, and the exhibits in arrangement and variety were exceptional. The attendance was all that could be expected during the four-day convention, and on the final afternoon and evening was greatly enhanced by a visiting delegation of some 200 Wisconsin engineers. On Wednesday afternoon the convention proper opened with a flourish of oratory. Presiding as temporary chairman, Fred Raven, national secretary, introduced as the first speaker Richard W. Parry, national president. President Parry had been greatly impressed with the exhibit. Chicago, he said, is one of the strongholds of the Association, and being a great industrial center, gives wonderful opportunities. It was his statement that the association in its entirety had been responsible for much of the progress made in mechanical lines in the last thirty years.

Welcome from the city of Chicago was extended by John E. Ericson, who considered the operating engineer the most important of all, as it was he who put life into the various inanimate things designed by other engineers. Fred Gielow, state president, responded, referring briefly to the yeoman efforts that had been made in the last two years in building up the state convention from a miniature affair to one closely approaching the national convention. It was his hope that other cities of the state would be inspired and make the most of the possibilities whenever they had the convention.

In an eloquent and inspiring address the Hon. Henry R. Rathbone welcomed the engineers in behalf of the Association of Commerce. Chicago, the state and the nation shared equally in his remarks. He was impressed with the fact that education and co-operation were the two fundamental cornerstones of the association.

Responding, James H. Harris, silver-tongued orator of the N. A. S. E., referred to the long tedious climb of the association in arriving at its present position. One thing it had learned was the great lesson of harmony. Between engineers co-operation was never lacking. One helped the other and the engineer of the small plant was accorded the same respect as the men in charge of the larger stations, and reasonably so, as the one required as much knowledge as the other.

Robert Carr spoke in behalf of the manufacturers. He pointed out the need of higher education for the engineer who is to wrestle with the more intricate problems of the present and the future. The great competition now developing necessitates economy in all branches of a business. Efficient power production is essential, so that the management and the engineer must work hand in hand to meet it.

In responding, Joseph O'Connell expressed appreciation of the good things said about the engineer by the manufacturers and representatives of chambers of commerce. He would like to see them put their remarks into practice by placing the engineer in the position of importance he deserves.

"Dad" Beckerleg, the dean of the State Association and a founder of the national body, was reminded that they had built better than they knew. He had been impressed by the various remarks on education and co-operation and by comparison of the immense exhibit with those of earlier days.

President Gielow then took the chair. In his address he reviewed the work of the past year. His recommendations were for simple and practical educational work to suit the rank and file, co-operation with all operating engineering bodies to secure a state license law, more joint meetings and entertainments, more visiting, the provision of a fund for improving the morale and boosting where most needed, and the appointment of a welfare committee to choose advantageously the convention city.

With a few appropriate remarks Alfred Johnson officially opened the exhibits and the convention adjourned to meet daily thereafter in morning sessions. Practically all the time remaining was taken up by routine business. The secretary-treasurer reported a comfortable balance on hand. The state deputy reported the dropping of one association during the year. In the larger cities in the western part of the state the association was in a flourishing condition. Since 1919 there had been a net gain in membership of 345, bringing up the state total to 1,783. During the year Illinois No. 2, of Chicago, by an increase in membership of 55, showed a percentage gain of 21.6. It was the largest for the state, and so representatives of No. 2 were presented with the flag. The convention committee approximated net profits at $400. The credentials committee seated 51 delegates and reported 16 alternates present.

Between Moline and Springfield the latter was chosen as the next convention city. The following officers were

OFFICIAL PHOTOGRAPH OF THOSE ATTENDING THE CHICAGO N. A. S. E. CONVENTION

elected: President, A. C. Grantz, of Moline; vice-president, J. C. Rounds, of Springfield; secretary-treasurer, Stanley H. Raven, of Chicago. M. E. Harris was recommended as state deputy.

In his usual inimitable way "Dad" Beckerleg installed the newly elected officers. Presentations followed of a gavel and a past president's badge to the retiring president, Fred Gielow. Adjournment was taken to meet and welcome the visiting Wisconsin engineers arriving Saturday afternoon.

Anderson Convention of Indiana State N.A.S.E.

A successful convention and exhibition of power-plant apparatus was held Friday and Saturday, June 9 and 10, at Anderson, Ind., by the Indiana State Association of the N. A. S. E. The exhibition included the products of sixty manufacturers and attracted a large crowd of visitors.

The convention was opened Friday morning by Frederick L. Ray, chairman of the Convention Committee, who made the response to addresses of welcome by Mayor Blanchard Horne and Joe Hennings, secretary of the Chamber of Commerce. In his address, Mr. Ray said:

The purpose of our organization is threefold. First, to educate the engineer, thereby helping him to an education and a greater compensation for his labor; second, to build up a public sentiment in favor of laws that will safeguard the public against loss of life and property due to defective apparatus and incompetent operation; third, to build up among the engineers a fraternal spirit that will cause them to help one another in times of sickness and distress. This help is also extended in an educational way, so that the best engineers in our ranks are always ready and willing to give a younger brother of their experience.

An address was to have been made by Robert B. Keller, director industrial service department, International Correspondence Schools, on the subject of "A Twentieth Century Education," but Mr. Keller was kept away by the illness of his wife and his place was taken by Mr. Shumaker.

The first business session then began, with the appointment of committees, the official report, etc., followed by a paper on "The Solid Injection Oil Engine in Isolated Power Plants," by H. E. Briggs, of the Anderson Foundry and Machine Co., and a paper on "Power Plant Piping," by G. W. Smith, of the Pittsburgh Piping and Equipment Co. At noon adjournment was taken for the official photograph on the steps of the Court House; it included the engineers, ladies' auxiliary, exhibitors and visitors, and is reproduced herewith. The exposition was then officially opened with appropriate ceremonies and was attended by a large number of visitors.

Another business session was held in the afternoon, at which P. S. Schaller, superintendent of the steam division of the Westinghouse Electric and Manufacturing Co., read a paper on "Steam Turbine Development."

To boost attendance at the exposition, there were offered two cash prizes of $100 each to the holders of the lucky registration ticket, together with a $170 scholarship in the International Correspondence School. The prize for Friday night was awarded to E. J. McDonough, of Louisville, Ky., but it developed that he was a salesman, not an engineer, and he returned the $100 check to the committee in a sportsmanlike manner, leaving two prizes, together with the scholarship, to be awarded Saturday night.

Saturday morning a third business session was held and three papers were given, as follows: "Underfeed Stokers," by M. M. Masson, of the American Engineering Co.; "The Uniform Boiler Code, Why It Ought to Be the Indiana Law," by Jos. W. Hays, of the Jos. W. Hays Corporation; "Graphic Measurements," by D. J. Angus, of the Esterline-Angus Company.

At the concluding session Saturday afternoon, Indianapolis was chosen as the convention city for 1923. Mr. Ray was indorsed for national trustee, and the following officers were elected and installed: President, F. L. Clifford, Kokomo; vice-president, H. C. Carroll, Indianapolis; secretary, H. V. Wallace, Anderson; treasurer, E. G. Heager, Evansville; conductor, F. L. Griswold, Anderson; state deputy, F. L. Niel, Evansville. Mr. Wallace and Mr. Heager were re-elected.

Philadelphia Convention of the American Order of Steam Engineers

The thirty-sixth annual convention of the American Order of Steam Engineers was held at Philadelphia, Pa., June 5-9. There were eighty-five delegates in attendance, and many of the past worthy chiefs were present. While there were two or three contests in the selection of officers, the deliberations of the delegates were conducted with harmony and dispatch.

The meetings of the engineers were held on the upper floor of the Moose Auditorium on Broad Street. The main hall of this building was conveniently arranged and pleasingly decorated for the use of the American Supplymen's Association. There were sixty-seven booths occupied by various firms in the engineering supply field for the display of power-plant equipment and accessories. Several new devices were shown and the exhibit was generously patronized during the week.

The exhibition was officially opened on Monday evening. Roy C. Downs, of the American Supplymen's Association, presided. Addresses of welcome were made by Richard Wieglein, president of the Philadelphia City Council; John M. Lukens, chief of the Bureau of Boiler Inspection; and Clinton Shaw, chief engineer of the North East Manual Training School. George T. Crum, Supreme Chief Engineer, ably responded for his organization.

Visits of inspection were made to "The Evening Bulletin," the Widener Building and to the plant of the Sears-Roebuck Company.

There were enjoyable vaudeville entertainments on Tuesday and Thursday nights.

The following is the result of the election of the Supreme Officers of the American Order of Steam Engineers: George T. Crum, chief engineer; Horace Howlings, assistant chief engineer; George C. Davis, recording engineer; William S. Wetzler, corresponding engineer; John J. Kelly, treasurer; Howard Hill, senior master mechanic; Charles Eisle, junior master mechanic; William Stahler, inside sentinel; Ray Bowman, outside sentinel; Joseph L. High, chaplain; George W. Richardson, trustee.

The American Supplymen's Association elected officers as follows: President, J. Maurice Willits, Joseph Dixon Crucible Co.; vice-president, Andrew Lauterbach, the Lunkenheimer Co.; treasurer, John W. Armour, *Power;* secretary, W. J. Brice, Ford & Kendig Co.

Fred L. John, J. William Paineut and John J. Kelly formed the local executive committee.

DELEGATES, LADIES' AUXILIARY, EXHIBITORS AND VISITORS AT THE ANDERSON CONVENTION

News in the Field of Power

Coal Investigation Not To Be Pressed Now

Any investigation of coal prices by the Senate will probably be deferred pending further developments in the trade as to the operation of Secretary Hoover's price recommendations. This development followed a conference held by Senator Borah, chairman of the Senate Committee on Labor, with Secretary of Commerce Hoover. Senator Borah announced that if the operators and retailers work together and will co-operate to protect the public in the matter of prices, he would not favor at this time any investigation and would let the price proposition work itself out.

"But if the maximum which has been fixed by Mr. Hoover is going to be used by the operators as a minimum price and thus pushed on to the retailers, and the operators and retailers together take advantage of the situation to boost the price to the public," said the Senator, "I would favor an investigation to force a complete exposition with a view to laying the foundation for public control."

Federation Makes Suggestion for Hydraulic Laboratory

A national hydraulic laboratory is proposed in bills introduced simultaneously in the Senate and in the House of Representatives on June 13. The bill sets forth that the laboratory is to conduct research, experiments and scientific studies in connection with the problems of river hydraulics. An appropriation of $200,000 is authorized for the purpose.

The author of the bill is Senator Ransdell of Louisiana, who has specialized in waterway matters during a service of nearly twenty-five years in Congress. The plan grows out of the suggestion made in a recent speech by John R. Freeman. At the suggestion of Mr. Freeman the Federated American Engineering Societies brought about the proposal for the legislation.

Dean Kimball on Tour to Link East and West

To work for a greater unity of thought and effort between engineers of the West and of the East, Dexter S. Kimball, dean of the College of Engineering at Cornell, president of the American Society of Mechanical Engineers, and vice-president of the Federated American Engineering Societies, is on a tour that will bring him before engineering gatherings in a number of cities in the Middle West and on the Pacific Coast. The trip is in line with the continual efforts of Dean Kimball and of other engineering society officers to bring about a more pronounced national consciousness among engineers throughout the country. Among the cities to be visited are: Los Angeles; San Francisco; Portland, Ore.; Seattle; Spokane; Moscow, Wash.; Ogden, Utah; Salt Lake City; and Denver. The trip will end at Chicago July 30.

Dean Kimball's trip to the Pacific Coast will be in the nature of a homecoming, for he spent many years of his early life in that part of the country. He was with the Union Iron Works of San Francisco when that company built the battleship "Oregon" and other noted ships, he was graduated from Stanford University, and his family now live in or near Seattle.

Coal Industry Warned

"The public is suspicious about everything related to the coal business, and the more grudgingly the facts are made known the more suspicious the public becomes. Eventually the facts will be disclosed, whatever the opposition; and indeed the coal industry itself needs these facts as much as the public does, especially at a time of impending shortage like the present. However true it is that the coal industry, with all its experience, can best be its own physician, the public is becoming impatient for results, and it measures success by the price of coal. In his appeal last month for the co-operation of moral forces and good will in the coal business, Secretary Hoover talked plainly to the coal producers and said that if our coal industry does not govern itself it will surely be governed by the public. Just now the public is asking for facts."

—From a speech by Dr. George Otis Smith at the session of the Public Committee on Coal, of which Norman Hapgood is chairman, at the Engineering Societies Building in New York City, June 13.

State Water Rights Denied

A decision of paramount importance to the electrical industry has been rendered by Supreme Court of the United States in the case of the State of Wyoming versus the State of Colorado, the Greeley-Poudre Irrigation District and the Laramie-Poudre Reservoir and Irrigation Co. There is some question as to the exact purport of the decision due to the fact that Justice Van Devanter delivered the opinion without having reduced it all to writing. As a result, the text of the opinion is not available as this is written. Nevertheless it is known that the opinion has the effect of obliterating state boundaries in the matter of the use of water. States as such have no ground on which to base an appearance in court.

New York State's Water-Power Plans Outlined

At a recent meeting of the New York State Water Power Commission, Superintendent of Public Works Charles L. Cadle submitted preliminary plans for the state development of water power at Crescent dam on the barge canal. Filing plans for the commission's approval is the first step in carrying out the program adopted this year by the legislature to expend $1,000,000 to develop ultimately 16,000 hp. at Crescent dam and Vischer's Ferry.

The Vischer's Ferry plans, which will be virtually identical with the Crescent dam project, will be submitted at the next meeting of the commission.

It is proposed by the superintendent with the funds available to construct a power house at the south end of the Crescent dam which will house units capable of developing 8,000 hp.; from these as a beginning the production will range between 4,000 and 5,000 hp. When additional moneys are appropriated by the legislature, the development will be gradually extended.

Under the Robinson bill the electric current generated at the dam will be used to supply the needs of state structures within a reasonable area and the surplus sold after competitive bidding to distributing companies.

The water-power commission will advertise a hearing for June 29 on Mr. Cadle's plans, after which it will approve or disapprove the development. It is not expected to disapprove, since this was one of the recommendations of the Governor in his annual message and no weighty arguments were advanced against it at the time the law was passed.

Super-Power Corporation Plays Safe

The American Super-Power Corporation, which applied June 3 for a preliminary permit from the Federal Power Commission for the development of 12,000 cu.ft. per sec. of water in the Niagara River, on June 8 made a similar application to the New York State Water Power Commission. The reason for filing the same application with both the state and federal governments is doubtless the dispute that has just been started by New York State over the jurisdiction of the Federal Power Commission.

The certificate of incorporation of the American Super-Power Corporation, of Lewiston, Niagara County, New York, was filed at Albany on May 31, just three days before application for a permit was made at Washington. The duration of the corporation is to be 50 years, and its capital stock is only $10,000, divided into 100 shares.

175,000-Hp. Hydro Project for Pennsylvania

The Clarion River Power Co., in care of C. B. Hawley, Munsey Building, Washington, D. C., has applied for a preliminary permit covering the erection of a power house on the Clarion River and the building of a dam to a height of 240 ft. at a point two miles above the mouth of Mill Creek, near Ridgway, Pa. It is estimated that these works will make available 120,000 hp. of primary power. The plan is to install equipment sufficient to generate 175,000 hp. The power is to be used for public-utility purposes.

Power Company Shows How Industry Is Picking Up

A reliable indication of industrial activity is given by the amount of power used in any particular district where a large number of factories making different kinds of products are situated. This fact gives interesting significance to a report recently received from the Public Service Company of Northern Illinois, which supplies electricity for lighting and power purposes throughout the great industrial district around Chicago. The company reports that its contracts made for additional power during the first four months of 1922 are far in excess of those for the same period of 1921, and are, in fact, the largest for any four months since the boom year of 1920. The actual figures are approximately 300 per cent over those for 1921.

"A year ago," said an official of the company, "there was very little encouragement given us. The owners of the factories were pretty gloomy in a great many cases. It can be stated now that even in the instances of plants that are not yet in full operation, plans are being carried out for enlargement of productive capacity.

"There is no doubt in my mind that we have not only turned the corner with respect to the revival of industry, but have gone a considerable distance on the road to it. Our company is calculating on a heavy increase in both its power and gas business."

N. E. L. A. Burlesque Report Brings Many a Laugh

After having completed the work of turning out voluminous reports and other convention publications, the literary lights of the National Electric Light Association, feeling the need for "a bit of nonsense now and then," have brought forth the "Report of Report Reading Committee." The committee has turned out a masterpiece, but according to the report its chairman "left town before the report was printed," one member is "absent in Canada," a second "expired May 1," and the third is "unknown."

It is further stated that the report was "dictated but not read," "disapproved April 1, 1922," and "printed in the press of other business." The price to members is $9.75, and to non-members 15 cents.

Digging into the highly technical matter given in the body of the report, one finds many complaints, among the first of them being one dealing with commas. It appears that too many commas are being used, and "it is the opinion of the committee that the peak load has been reached." A table is given showing that commas used by Association committees in 1922 have reached the alarming number of 1,013,786,045. It is further stated that "the American comma has been almost driven from the market by cheap commas of German and Swedish manufacture."

Especial criticism was directed toward the practice of over-capitalization in reports, which, it is said, "continues unabated despite the lessons of the deflation period and the general business depression."

A patriotic protest is registered against the use of the term "British thermal unit." "Why not American thermal unit," it is asked?

Recommendation is made that "sentences carrying a voltage of more than 500 words should be laid underground, except when steel poles are available. Wooden poles are liable to buckle under the strain."

Finally, "It is recommended that next year no reports be sent in until at least two weeks too late for use. The expense of printing and the strain on the Report Reading Committee will be greatly lessened by such procedure."

Coming Conventions

Stoker Manufacturers' Association; J. G. Worker, Eau Claire, Wis. Semiannual meeting at Groton Point, Conn., June 19-21.

National District Heating Association; D. L. Gaskill, Greenville, Ohio. Annual convention at Cedar Point, Ohio, June 20-23.

American Institute of Electrical Engineers, 29 West 39th St., New York City. Annual convention at Niagara Falls, Ont., June 26-30.

American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. Annual meeting at Atlantic City, N. J., June 26-July 1.

Canadian Association of Stationary Engineers; G. C. Keith, 51 Wellington St. West, Toronto, Ont. Annual convention and exhibition at Kitchener, Ontario, June 27-29.

National Association of Stationary Engineers; Fred W. Raven, 417 South Dearborn St., Chicago, Ill. Annual conventions and exhibitions of the State Associations scheduled as follows:

Connecticut, at New Haven, June 23-24; Fred C. Sutorius, 890 Chapel St., New Haven.

New England, at Springfield, Mass., July 12-14; James Morgan, 53 Devonshire St., Boston.

Michigan, at Kalamazoo, July 19-21; A. M. Adams, 1307 Stockbridge Ave., Kalamazoo, Mich.

Wisconsin, at Madison, July 26-28; C. Z. Wise, 204 South Carroll St., Madison.

Minnesota, at Minneapolis, Aug. 9-11; C. A. Nelsen, 800 22nd Ave., N. E., Minneapolis.

Iowa, at Des Moines, Sept. 10-11; Abner Davis, Room 16, Waterhouse Block, Cedar Rapids, Iowa.

Universal Craftsmen Council of Engineers; Thomas H. Jones, 33 Linden Ave., Cherrydale, Va. Annual convention and exhibition at Cleveland, Aug. 7-11.

Society Affairs

New Jersey State Association, N. A. S. E., elected the following officers at its recent annual convention: John Mycock, president, Trenton; William Sitzler, vice-president, Newark; Samuel Clark, secretary, Jersey City; Joseph Flynn, treasurer, Elizabeth; Zolson Bedwell, conductor, Millville; William Green, doorkeeper, Jersey City. The next convention will be held in Trenton, N. J., in June, 1923.

Personals

Dr. Robert H. Fernald has been made president of the Engineers' Club of Philadelphia. He will serve until July 1, 1923.

Merritt B. Miller, formerly in the design department of the Westinghouse company at East Pittsburgh, Pa., has resigned to take a position with the Central Michigan Light and Power Co., of Alma, Mich.

Frederick Krug is now with the Porto Rico Railway, Light and Power Co., as superintendent of the La Plata hydroelectric plants at San Juan, Porto Rico. He had been for several years with the New York & Hondural Rosario Mining Co., San Juancito, Honduras, C. A., as assistant superintendent and acting superintendent of the electrical department until his resignation in the fall of last year.

N. A. Carle, chairman of the technical national section of the N. E. L. A., recently did his bit toward quelling the crime wave by bringing about the capture of a burglar near his home in Newark, N. J. Mr. Carle spied the thief entering a neighbor's house, and Mrs. Carle telephoned for the police. After his capture the burglar admitted having robbed a number of other Newark houses.

C. G. Adsit, executive engineer of the Georgia Railway and Power Co., has been elected vice-president of the company. The position had been vacant since the resignation some months ago of W. H. Glenn. Mr. Adsit, who is a director of the company, became connected with it in 1911, as resident engineer on the Tallulah Falls hydroelectric development. Later he was made consulting engineer and chief engineer, and had charge of the development of Methis dam and reservoir and Burton dam and reservoir, and now is in charge of the Tugaloo development. He was made executive engineer April 1.

Business Items

The Russell-McDonald Engineering Co., 1276 West Fourth St., Cleveland, Ohio, has taken over the manufacture and sale of Gradeca combustion control equipment and the Auto-Skim surface

blowoff, both of which were formerly handled by the Combustion Improvement Corporation. Both devices were invented by J. M. Wilson, formerly plant engineer with the Standard Parts Co., at Canton, Ohio, who has joined the company as engineer in order to give his attention to the development of these two pieces of equipment.

Heyl & Patterson, Inc., Pittsburgh, Pa., has resumed its pulverized-coal business, which had been temporarily suspended since the death of E. C. Covert, by placing C. F. Herington in charge. Mr. Herington is well known as the author of the book "Pulverized Coal as a Fuel," and has spent nine years in pulverized-coal work. The company will design, manufacture and erect complete pulverized-coal plants.

Trade Catalogs

Valves & Fittings—National Valve and Manufacturing Co., Arsenal Station, Pittsburgh, Pa. Catalog No. 5, 80 pages, containing a lot of useful information on pipes and fittings, together with full specifications, tables, charts, etc., attractively bound in flexible leather covers. The booklet is full of tables, the data being given in highly condensed form.

Metallic Packing—Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill. A 25-page pamphlet dealing in particular with John Crane metallic packing, its installation and advantages, with a brief treatment of condenser tube disintegration from various causes and an enumeration of a number of electrochemical tests to prove that the company's product eliminates electrolysis.

Fans—Clarage Fan Co., Kalamazoo, Mich. Catalog No. 52, 84 pages, which represents a thorough-going effort not only to describe the Clarage Multiblade Fans for heating, ventilating and humidifying systems, but also to give in a general way the principles of operation of such systems. Complete specifications are given, as well as a number of useful charts.

Fuel Prices

FUEL OIL

New York—June 15, Port Arthur light oil 22@25 deg. Baumé 3⅞c. per gal.; 30@35 deg., 4¾c. per gal., f.o.b. Bayonne, N. J.

Chicago—May 20, for 24@28 deg. Baumé, 85@90c. per bbl.; 21@36 deg., 2⅜@ 2½c. per gal. in tank cars, f.o.b. Oklahoma refinery, or freight adjusted to conform.

Pittsburgh—June 14, f.o.b refinery, Pennsylvania, 36@40 deg. 5½c.; Kentucky fuel oil, 26@30 deg., 3¾c. per gal. Gas. oil, 32@34 deg., 3c. per gal.; 36@38 deg., 3¼c.; 38@40 deg., 3½c. Western. 24@30 deg., 85c. per bbl.

Philadelphia—June 11, 26@28 deg. Baumé, Oklahoma, 95c@$1.00 per bbl.; 30@34 deg., Oklahoma (group 3), 3⅛@ 3¼c per gal.; 16@20 deg. Seaboard, $1.15@$1.25 per bbl.

Cincinnati—May 27, for 26@30 deg. Baumé, 5½c.; Diesel 32@24 deg., 5½c. per gal.; distillate 39@40 deg., 6c.

Cleveland—May 27, 26@30 deg. Baumé, 4½c. per gal.

BITUMINOUS COAL

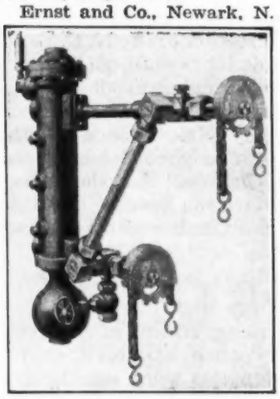
The following table shows the trend of the spot steam market in various coals (mine-run bases, f.o.b. mines):

Coal	Market Quoting	June 5, 1922	June 12, 1922
Pool 1,	New York	$4.00–4.75	.....
Smokeless,	Columbus	2.75–3.25	$3.50
Clearfield,	Boston	3.00–3.40	3.00–3.50
Somerset,	Boston	2.90–3.40	3.00–3.50
Kanawha,	Columbus	2.75–3.00	3.25–3.50
Hocking,	Columbus	2.85–3.20	3.50–3.75
Pittsburgh No. 8	Cleveland	.....	3.60–3.75
Franklin, Ill.,	Chicago	.....	.....
Central, Ill.,	Chicago	.....	.....
Ind. 4th Vein,	Chicago	.....	.....
West Ky.,	Louisville	3.20–3.40	3.75
Big Seam,	Birmingham	1.50–1.90	1.75–2.00
S. E. Ky.,	Louisville	2.50–3.25	3.50

Condensed-Clipping Index of Equipment

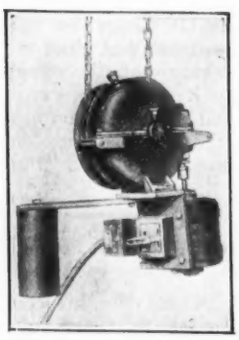
For quick reading and convenient filing. These items have not been published before in "Power"

Valves, Gage Glass "Power," 1922.
Ernst and Co., Newark, N. J.



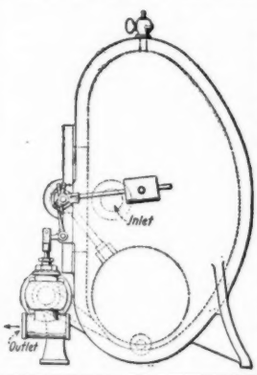
A set of gage-glass valves, of which one has an extension so that the gage glass is held at an angle instead of vertically. By this means the operator is able to see the water level from directly underneath, without having to step backward, as in the case of the vertical glass. This feature is of use principally, of course, on very high boilers. The angle and inclination of the glass can be varied by lengthening or shortening the extension nipple of the top valve, so that the glass can be set in the position most favorable under existing conditions.

Hoist, Motor for Operating "Power," 1922.
New Jersey Foundry and Machine Co., 90 West St., N. Y. City



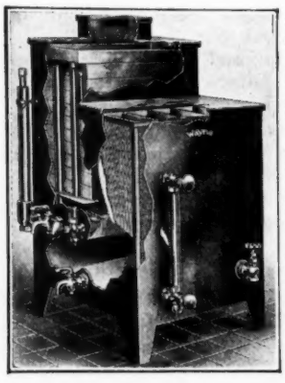
The "Handiman," an electric motor intended to eliminate manual labor in the operation of chain hoists of over five tons capacity. It is hung in the bight of the operating chain of such a hoist, and when the current is on, overhauls the chain more rapidly than a man could do it (138 ft. per min., according to the makers). It is designed for a chain pull of 130 lb., weighs about 165 lb. and is counterbalanced so as to hang level. It is fitted with a ¾-hp. electric motor (a.c. or d.c.). The sheave has a V-shaped rubber tread that fits any size and pitch of chain, and is driven through worm gearing. It is not intended that the "Handiman" take the place of an electric hoist, but that it may be used by those who wish greater speed with a hand-operated hoist that is already installed. It is suggested also for use with several hand-operated hoists, especially if they are not all used constantly, since it can be carried from one to the other as desired.

Trap, Steam, Automatic "Power," 1922.
Golden-Anderson Co., Pittsburgh, Pa.



A float-operated steam trap, the essential features of which are simplicity and durability. All the working parts are of bronze; the discharge valve, which is of large area, is on the outside and is readily accessible for examination or replacement without disturbing the body of the trap. The connection between the float and discharge valve is made by means of a spindle and links. In operation, the condensation enters through an opening in the side, and the float gradually rises, carrying the weighted lever with it. When the float nears the top, it forces the discharge valve open and the pressure in the trap discharges the water through the outlet, until the float falls to a point where the weighted lever forces the valve shut and the cycle is repeated. The weighted lever is a positive indication of the trap's operation.

Filter, Oil "Power," 1922.
Wayne Oil Tank and Pump Co., Fort Wayne, Ind.



A small continuous-flow oil purifier made in two sizes, for handling either 30 or 60 gal. per hour of dirty engine oil. The oil is poured in at the top, passing first through a screen that removes the coarse foreign matter, and then downward into a heating compartment where its temperature is raised by either steam or electricity to about 180 deg. F. It then flows up at one side and out over a number of shallow trays, into which, on account of the very slow movement of the oil, the solid impurities are precipitated. Water also leaves the oil here and passes down to a compartment at the bottom, from which it overflows to a drain. About 85 per cent of the dirt in the oil is removed in the trays, and the rest is caught in several fine cloth filter bags hanging in the last compartment, from which the clean oil is drawn out.

For a permanent file of new and improved power-plant equipment, clip and paste on 3 x 5-in. cards. (Patented Aug. 20, 1918.)

New Plant Construction

PROPOSED WORK

Cal., Bakersfield—The Atchison, Topeka and Santa Fe R. R., Railway Exchange, Chicago, Ill., is having plans prepared for machine shops, etc., on 20-acre site here. Estimated cost $400,000. R. B. Ball, 221 South Broadway, Los Angeles, Engr.

Cal., Fresno—San Joaquin Light & Power Co., 1801 Tulare St., plans to build a 10 story office building, J and Tuolumne Sts.. Estimated cost $750,000. Architect not selected.

Cal., Los Angeles—J. Beoman & D. Trattner, Union Bank Bldg., are having plans prepared for 6 story, 135 x 155 ft. apartment building, including steam heating system, on Wilshire Blvd. Estimated cost $600,000. Russell & Alpaugh, 1106 Story Bldg., Archts.

Cal., Mountain View—St. Joseph College of Cupertino, is having plans prepared for 4 story college and dormitory buildings between here and Los Gatos. Estimated cost $1,250,000. L. J. Devlin, Pacific Bldg., San Francisco, Archt.

Cal., Oakland—Athens Athletic Club, c/o N. De Vaux, Pres., 62 Farragut St., is having sketches prepared for 6 story office, club and railroad terminal on 14th and Franklin Sts. Estimated cost $1,900,000. Bliss & Faville, Balboa Bldg., San Francisco, Archts.

Cal., Oakland—The Tribune Publishing Co., Oakland Tribune Bldg., is having sketches prepared for 15 story newspaper publishing plant and offices on 13th and Franklin Sts. E. T. Foulkes, Crocker Bldg., San Francisco, Archt.

Cal., Presidio (San Francisco P. O.)—J. A. Wetmore, Acting Superv. Archt., Treas. Dept., Wash., D. C., is receiving bids for pump house, pump equipment and fire protection system at the Marine Hospital, here. Plans may be obtained from J. W. Roberts, Post Office Bldg., San Francisco.

Cal., Reedley—The Union High School Trustees, will receive bids until June 30 for high school buildings, including steam and hot air heating systems. Estimated cost $450,000. Trewhitt & Shields, Rowell Bldg., Fresno and N. F. Marsh, Broadway Central Bldg., Los Angeles, Archts. Noted Feb. 7.

Cal., Sacramento—The Elk Lodge, Elk Bldg. plans to build a 6 story 80 x 160 ft. lodge building on 8th and K Sts. Estimated cost $500,000. Architect not selected.

Cal., San Luis Obispo—The city council will receive bids until June 26 for pump, 500 gal. per minute against head 125 lbs. W. B. Burch, Engr.

Cal., Stockton—The city is having plans prepared for 6 or 7 story city hall on Weber Ave. and American St. Estimated cost $600,000. Davis-Heller-Pearce Co., Weber and California Sts., J. Losekann, Elks Bldg., and P. Sala, Delta Bldg., Archts.

Cal., Turlock—The Turlock and Modesto Irrigation Districts are having specifications prepared for hydraulically operated spillway gates for Don Pedro dam. Estimated cost $62,000. R. V. Meikle and P. Jones, Ch. Engrs., Turlock and Modesto Districts respectively.

Conn., Fairfield—The High School Committee plans to build 2½ story high school in 3 units, on the Post Road. Estimated cost $300,000. O. C. S. Ziroli, 211 State St., Bridgeport, Archt.

Conn., New Britain—The Chamber of Commerce, New Hotel Committee, 140 Main St., plans to build hotel on West Main St. Estimated cost $900,000. Architect not selected.

Del., Wilmington—The J. D. Sisler Co., Third and King Sts., is in the market for machinery and equipment for proposed cold storage plant.

Fla., Quincy—The City Council will receive bids until July 18 for enlarging and equipping electric light and water plants. Estimated cost $40,000. Noted May 23.

Ga., Atlanta—Stevens Bros. & Co., 806 Forsyth Bldg., is in the market for one 50 and one 250 hp. Corliss engines.

Ill., Chicago—W. W. Ahlschlager, Archt., 65 East Huron St., is receiving bids for a 10 story, 137 x 150 ft. addition to hotel, including steam heating system on Kenmore and Granville Sts., for The Albert Hotel & Bldg. Corp., c/o Archt. Estimated cost $1,500,000. Noted June 13.

Ill., Chicago—The Allerton House Co., 369 Lexington Ave., New York, is having preliminary plans prepared for 20 story, 109 x 150 ft. hotel, including steam heating system, on Michigan Blvd. and Huron St. Estimated cost $4,000,000. Murgatroyd & Ogden 369 Lexington Ave., New York, Archts.

Ill., Chicago—W. P. Doerr, Archt., 28 East Jackson Blvd., is receiving bids for 10 story, 142 x 176 ft. apartment hotel, including steam heating system, on Hyde Park Blvd. and East 53d St., for the East End Park Building Corp. Estimated cost $2,000,000.

Ill., Chicago—St. Chrysostom's Episcopal Parish, c/o Clark & Walcott, Archts., 8 East Huron St., plan to build a church, including steam heating system, on 1440 North Dearborn St. Estimated cost $1,000,000.

Iowa, Maquoketa—The Bd. Educ., C. W. Farr, Secy., will receive bids until July 6 for 2 story high school and boiler house. Estimated cost $200,000. A. H. Ebeling, 819 Kahl Bldg., Davenport, Archt. Former bids rejected.

Iowa, Oskaloosa—The city voted $370,000 bonds for hydro-electric development on the Des Moines river.

Kan., Ansdale—The city will soon award the contract for 20.5 mi. electrical transmission line, including distribution systems for three towns. Estimated cost $37,000. Ruckel Engr. Co., Hutchinson, Engrs.

Kan., Wichita—The United Electric Co., 137 North Emporia Ave., is receiving bids for wireless station, including generator and equipment, on College Hill. Estimated cost $10,000. O. Taylor, 124 North Market St., Engr.

Kan., Phillipsburg—The city, W. N. McIlvain, Clk., is having plans prepared for purification and pumping plants, including 6½ mi. 8 in. water main. Estimated cost $100,000. Black & Veach, Mutual Bldg., Kansas City, Engrs.

Ky., Hazard—The city, A. G. Taylor, Clk., will receive bids until June 29 for million gal. filter plant, pumping station, pumps, reservoir, distribution mains and appurtenances. The J. N. Chester Engineers, Union Bank Bldg., Pittsburgh, Pa., Engrs.

Ky., Louisville—The Seelbach Hotel Co., 4th St. and Winter Ave., plans to build 15 story hotel on Third and Guthrie Sts. Estimated cost $4,000,000. Architect not selected.

La., New Orleans—The Sewerage and Water Bd., A. G. Moffat, Secy., Room 303, 526 Carondelet St., will receive bids until July 19 for furnishing one 6,000 kw. turbine and accessories.

La., Shreveport—The Standard Oil Co. of Louisiana plans to build 150 mi. 12 in. and 200 mi. 10 in. pipelines and install additional pumping equipment at Oxford, Weaver's Spur, Cypress, Boyce, Bunkie and Melville. Estimated cost $5,000,000.

Mich., Detroit—The Park Davis Co., 2951 Atwater St., is having plans prepared for a 2 story, 75 x 100 ft., power house, including steam heating plant, power boilers, and coal-handling equipment, on Atwater St. Estimated cost $75,000. Smith, Hinchman & Drylls, 710 Washington Arcade, Archts.

Mich., Grand Rapids—Holabird & Roche, Archts., 104 South Michigan Ave., Chicago, Ill., are receiving bids for 13 story 87 x 150 ft. hotel and bank, including steam heating system, on Monroe and Ionia Aves., for the Morton Hotel Co. Estimated cost $750,000.

Mich., Sault Ste. Marie—The U. S. Engineer Dept., 337 Federal Bldg., Detroit, will receive bids until June 28 for furnishing and erecting 6 operating engines for Poe Locks, including motors, controllers and resistances, electric winding drums for 3 pairs of service gates, seven 20 hp. motors, 3 phase, 60 cycle, 440 volt.

Minn., St. Paul—H. W. Austin, City Purch. Agt., City Hall, will soon award the contract for 2 and 3 story, 150 x 250 and 48 x 90 ft. school on Isabel & Congress Sts., for Dept. of Educ., L. R. S. Ferguson, Comr., City Hall. Estimated cost $420,000.

Mo., St. Louis—F. Bordefeld, Box 135, Route 30, McLaren Station, is in the market for 12 hp. engine.

Neb., Scottsbluff—W. O. French, Secy. Bd. of Educ., will receive bids until June 30 for 3 story, 198 x 343 ft. Junior and Senior High School, including low pressure heating system on Broadway. Estimated cost $300,000. R. A. Bradley & Co., Archts.

N. J., Camden—The Bd. of Freeholders plan to build an electrical power house. Estimated cost $90,000. J. A. Albertson, Engr.

N. J., Clinton—B. G. Lewis, Comn., State House, Trenton, will receive bids until June 23 for artesian well and pump for the Reformatory for Women. Estimated cost $8,000. A. B. Mills 142 State St., Trenton, Engr.

N. J. Vineland—Stearns & Woodnut, Archts., Stephen Girard Bldg., Phila., Pa., is receiving bids for 2 and 3 story 60 x 175 ft. building, including steam heating system for the Newcomb Hospital here. Estimated cost $250,000.

New Mex., Albuquerque—The Atchison, Topeka & Santa Fe R. R., Railway Exchange Bldg., Chicago, Ill., is having plans prepared for boiler shop, here. Estimated cost $500,000. C. F. W. Felt, Ch. Engr., E. A. Harrison, Archt., c/o owner.

N. Y., Albany—The City Savings Bank Co., W. S. Hackett, Pres., will receive bids until July 10 for office building on Empire Theater site. Estimated cost $700,000. M. T. Reynolds, 100 State St., Archt.

N. Y., Buffalo—W. C. Maltby, 21 Maryland St., is in the market for one 50 hp., 2200 volt, 25 cycle electric motor.

N. Y., Buffalo—The Niagara Linen Supply Co., 353 Louisiana St., plans to build 26 x 55 ft. boiler house. Estimated cost $5,000. Quotations wanted for boiler, 60 hp. or larger.

N. Y., Falconer—The Niagara, Lockport & Ontario Power Co., Lockport, has taken over the local Western N. Y. Electric Co., and plans to build a substation in Allen St. extension here; also high power transmission lines throughout local manufacturing districts from substation to Jamestown.

N. Y., New York—The Bd. Educ., 500 Park Ave., have had plans prepared for 6 story school, including steam heating system, on Second Ave. and 67th St. Estimated cost $1,800,000. C. B. J. Snyder, Concord St., Brooklyn, Engr. and Archt. Noted Jan. 3, 1921.

N. Y., New York—The Bureau of Yards & Docks, Navy Dept., Wash., D. C., received bids for boiler with mechanical stoker at the Naval Hospital here, from Heine Boiler Co., 1120 Pa. Bldg., Phila., $19,077; Almiral & Co., 1 Dominic St., $20,685, and Shevlin Engr. Co., 110 West 34th St., $20,688.

N. C., Charlotte—F. Hayman, 33 North Tryon St., plans to make alterations to cold storage plant and install additional machinery. Estimated cost $50,000. Engineer not selected. Prices wanted on machinery.

Ohio, Brookfield Center—The Penna.-Ohio Power & Light Co., Sharon, is having plans prepared for a high tension line from here to Masury and Vienna also the construction of a large sub-station here. Private plans.

Ohio, Cleveland—The Bd. Educ., East 6th St. and Rockwell Ave., will receive bids until July 3 for 3 story addition to high school, including steam heating system, on West 93d St. and Willard Ave. Estimated cost $925,000. W. R. McCornack, 1800 Cadwell Ave., Archt.

Ohio, Cleveland—The city, Purchasing Dept., City Hall, is in the market for steam boiler and superheater.

Ohio, Cleveland—The Power Improvement Company, C. F. Fox, Pres., 928 Williamson Bldg., plans addition and alterations to factory and power plant, on Cedar Ave. and Ashland Road. Estimaed cost $350,000. G. E. Peterson, 928 Williamson Bldg., Archt.

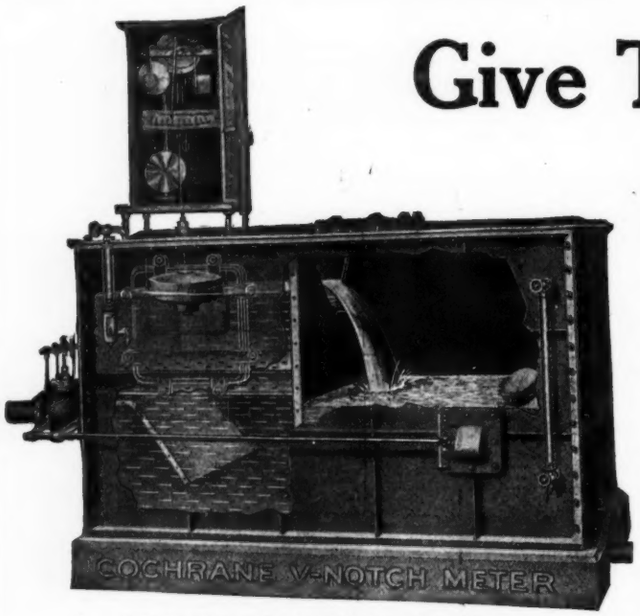
Ohio, Cleveland—J. Struziak, 8126 Wade Park Ave., had plans prepared for 17 x 43 ft. boiler room and garage at 4166 East 136th St. Estimated cost $40,000.

Ohio, East Cleveland (Cleveland P. O.)—The Lynndale Realty Co., c/o A. M. Wright, Fidelity Mortgage Bldg., Cleveland, plans to build 2 commercial and 10 apartment buildings, 3 stories each, at 14905 Euclid Ave., Cleveland. Esimated cost $1,000,000. J. F. Steffens, 611 Fidelity Mortgage Bldg., Archt.

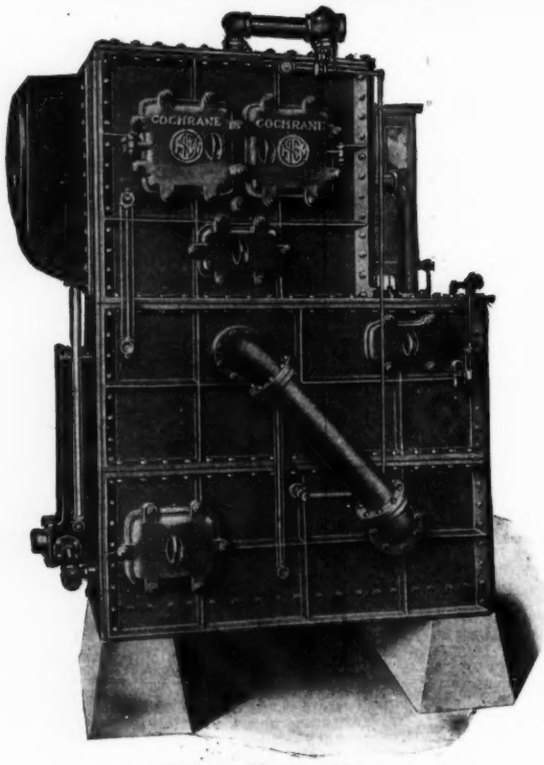
Ohio, Grafton—The state has purchased a site in North Eaton township and plans to build hospital for the insane. Estimated cost $1,000,000. R. S. Harsh, Ohio Bldg., Columbus, Archt.

"TO ECONOMIZE—COCHRANIZE"

Give Them Facts



Interior View of Cochrane Independent Meter



Cochrane Metering Heater

WHEN you want the management to appropriate money for new equipment or for changes, can you give them accurate information regarding the present condition of the plant and the improvement in economy which may be expected from the new apparatus?

Isn't it asking a good deal to suggest that they should lay out more money if you are not able to tell them definitely what the benefit will be?

This applies particularly to boiler room equipment, such as soot blowers, water softeners, feed water heaters, furnace linings, damper regulators, grates, stokers, CO_2 meters, and all appliances having an influence upon boiler efficiency.

To determine boiler efficiency, it is necessary to measure the evaporation; in other words, to provide a feed water meter. A meter shows at once the present condition of the plant and the improvement resulting from each change in operating methods or from the installation of improved apparatus.

The Cochrane Metering Heater is a feed water meter which also saves fuel by utilizing exhaust steam to heat the boiler feed water.

Our Book on Cochrane Heaters and Meters points out the many different ways in which boiler room economy can be improved. This book is sent free upon request.

The advice and suggestions of our Engineers regarding any specific problem relating to improving steam-plant economy are supplied free wherever Cochrane apparatus can be used effectively in making the improvement.

We would be glad to help you in collecting and arranging the facts relating to your plant.

H. S. B. W.-COCHRANE CORPORATION

Formerly Harrison Safety Boiler Works

17th and Clearfield Streets, Philadelphia, Pa.

Also at Atlanta, Baltimore, Birmingham, Boston, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Greenville, S. C.; Hazleton, Pa.; Houston, Indianapolis, Kansas City, Little Rock, Los Angeles, Minneapolis, New Orleans, New York, Pittsburgh, Richmond, Rochester, St. Louis, Salt Lake City, San Francisco, Seattle, Syracuse, Tucson, Toronto, Montreal, Halifax.

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